GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

PARALLELING PUMPS · 82
VENTING FEED HEATERS · 92
COMMUTATOR TIPS · 122

Power

April
1952 · 50¢

A McGRAW-HILL PUBLICATION

Making h-p h-t pipe dreams come true—p. 2

Handling "devil's snow"

You've only won half the battle when your dust collecting system has captured the "devil's snow"... The final cost of cleanliness in your plant area depends on the efficiency of your disposal system. Here are two A-S-H developments that will give you better housekeeping at lower cost:

Automatic Sequence Head

A single pushbutton controls the entire dust handling system. Dust is sequentially removed from the hoppers, and the air is loaded with just the right amount of dust for maximum efficiency.

Automatic Dust Conditioner

Designed for plants using trucks or railroad cars for disposal, this new machine positively prevents accidental escape of dust in unloading, and gives an ideal mixture of dust and water for handling and transport.

Ask your nearest A-S-H engineer how these pioneering developments can help you solve your dust problem.

THE ALLEN-SHERMAN-HOFF CO.
Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.
Offices and Representatives in Principal Cities

HYDROJET (ASH) **HYDROVAC**
(hydraulic) (pneumatic)
materials handling systems

Emptying a few gondola cars a day... or a few thousand a week?

LINK-BELT equipment does either job... better

Get an unbiased recommendation for the right type of railroad car unloader for your needs

Be sure you get the right railroad car unloader for your particular requirements. Only Link-Belt builds both types — the Rotary Dumper for large users ... the low-frequency Car Shaker for smaller operations.

You'll save time and manpower with either. For both are precision-engineered by Link-Belt to do a specific job faster ... more gently ... at lower cost to you.

It's easier on cars ... thanks to exclusive low-frequency vibration. And the Link-Belt Car Shaker also has a much lower noise level. Positive action gets most hopper bottom cars "broom-clean" in a few minutes. Especially good for damp, sticky materials. Write for Book 2345.

Unloads gondolas in 90 seconds or less (including return to upright position)! Simple, automatic, fool-proof — Link-Belt Rotary Car Dumper can be operated by unskilled labor. Takes all types of open top cars — any length, width or height ... up to 90-ton capacity. Book 2048-A has complete data.

LINK-BELT

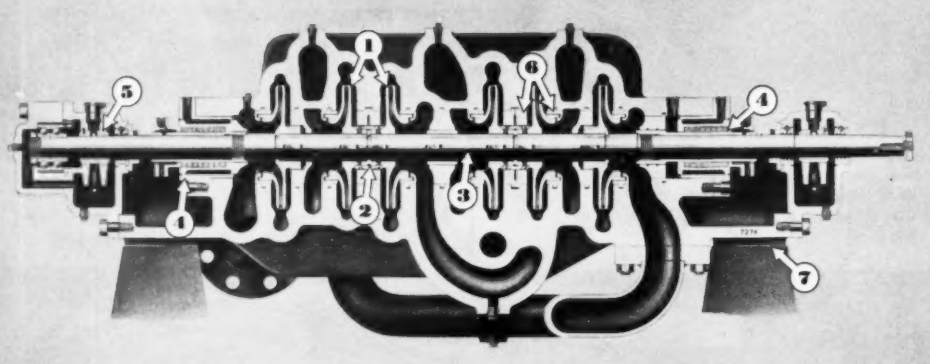
CAR SHAKERS and ROTARY DUMPERS

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in Principal Cities. 12,351

Simplicity, long life, easy maintenance

CAPACITIES TO 1000 GPM
PRESSURES TO 1200 PSI
TEMPERATURES TO 350-400F

1. Opposed impellers balance axial thrust.
2. Impeller mounting provides leak-proof shaft sealing between stages.
3. Exposed shaft insures freedom from distortion.
4. Removable stuffing boxes permit flexibility in shaft sealing arrangement.
5. Split sleeve radial bearings are standard.
6. Positive interstage wearing ring seals eliminate leakage.
7. Casing support insures coupling alignment.



You get them all with...

DE LAVAL
OPPELLER PUMPS

Look at the seven outstanding features shown in the cross-section and you'll see why De Laval Boiler Feed Pumps stay on the job for years...trim maintenance costs. Suitable materials are available for all water conditions. Write today for bulletin giving full application and specification data.

Boiler Feed Pumps

DE LAVAL STEAM TURBINE COMPANY
Trenton 2, New Jersey

DL 149

Power

APRIL 1952 • VOLUME 96 NUMBER 4

ENGINEERING AND MANAGEMENT

Fireman—first class: an editorial	69
High-pressure high-temperature pipe dreams come true	73
High-voltage ac motor controller . . . today	80
Study your centrifugal pumps before paralleling	82
How to bring coal- and ash-handling cost to small-plant level	86
Arrecifes steam-electric plant helps Venezuela grow	88
Venting feedwater heaters	92
Avoid turbine blade corrosion and erosion	94
Re-refined lube oil paid off in diesel plants	98
The lazy evaporator: Case No. 8 in a series	100
Power's data sheet No. 238: Explosive limits in air	101

PLANT OPERATION AND MAINTENANCE

Sure way to low-cost steam—planning, equipment, operation	105
Operators' Notebook No. 52: Boiler blowoff valves	108
Traps to step up condensate removal	110
Diesel-oil ashes tell this inside story	112
What to do about shaft currents that ruin bearings	114
Refrigeration questions and answers	116
How does the plant man react to radiant heating?	118
Keep lubrication oil out of air	120
These tips will help pin down your commutator troubles	122

Practical ideas	126	How to	140
Plant problems	132	Headwork	142
Argument corner	138	Marmaduke Surfaceblow	144

READER SERVICE SECTION

Defense digest	148	New free bulletins	165
Power news	150	George Edwards	168
Technical briefs	152	Engineer's bookshelf	196
Plant equipment news	156	My biggest boner	218

April 1952 **POWER** Vol 96—No. 4
(Member ABC and ABP)

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PIPE WELDING in the past quarter century has become an indispensable tool. Its development, paralleling advances in metallurgy and fabrication, makes modern high-pressure high-temperature piping practical. So it's fitting that our cover introducing the piping article on pp 73-79 emphasizes this dramatic phase of installation.

The photographer (Richard W St. Clair, APSA, ARPS) caught the skilled welder laying one of many beads involved in the 24-hr job of making a main-steam joint at the Salem Harbor Station. A dc shielded metallic arc deposits metal like that of the alloy pipe. Each bead must be painstakingly cleaned to insure a good bond for the next. Completed joint is stress-relieved with watercooled induction heating coils.

Next month . . .

■ For some time we've wanted to do a comprehensive piece on boiler and machinery insurance—what forms are available, how to apply them to your needs, what you get aside from pure "protection." A May roundup answers these questions and many more.

■ Grounds are an essential part of an electrical system, but only when they're where you want them. For help in locating the unwanted kind, see next month's practical article.

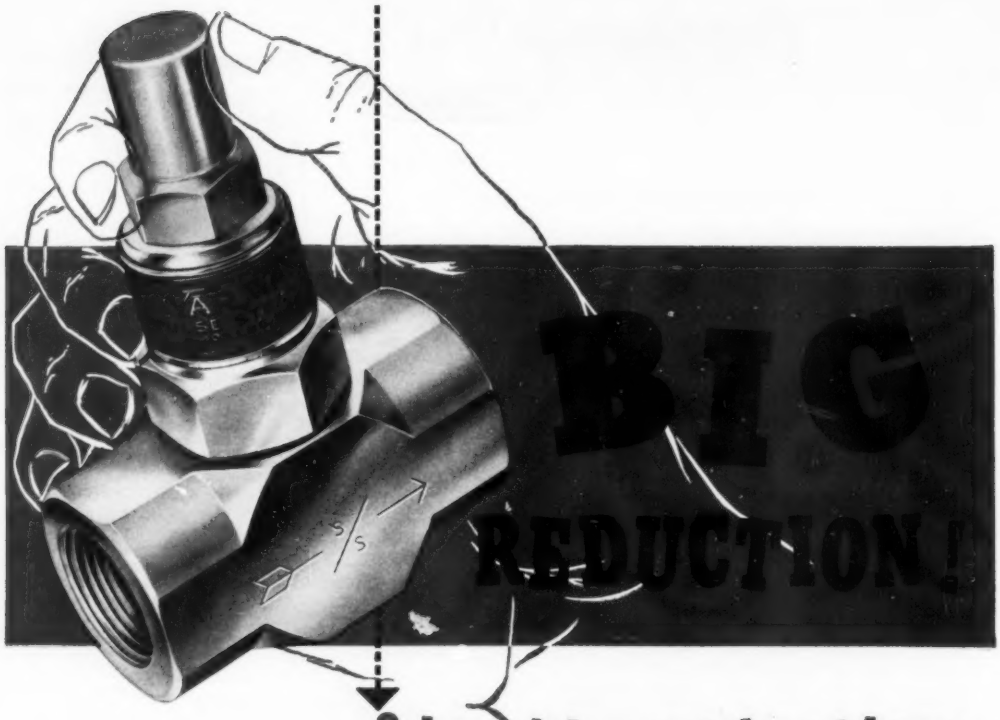
■ Power engineers in the pulp and paper industry have been doing some unusual things and a lot of usual things in a high-class way. A survey of design trends in this field is sure to give you some ideas for application in your own plant.

■ Another batch of tested maintenance hints is coming up. Watch for them, put them to work for you.

. . . *and future months*

■ We never knew there were so many kinds of piston rings until Steve Elonka began to prepare a new type of special section for POWER's operating and maintenance readers.

We're all steamed up and we think you'll be, too, when you see the practical ring manual he's producing.



8-hour job now takes 4 hours

At a western magnesium reduction plant something besides magnesium has just been reduced. The steam at the end of the 1½ mile long steam line wasn't so hot—and neither was the production record of the plant at that location.

Then 26 old-type steam traps were replaced with Yarway Impulse Traps. Now there is only a 15° temperature drop from the boilers to the end of the line. *Most important, the plant 1½ miles from the boilers is now able to do work in 4 hours that previously took 8 hours.*

That's trap efficiency! It's evidence of the fact that Yarways are designed to send the most premium B.T.U.'s at top temperatures into your process or product. *They get equipment hotter, sooner . . . and keep it hot.*

Other Yarway features—small size, one moving part, easy installation, low maintenance, low cost, stainless steel construction. Nearly 750,000 Yarways have already been installed. For your Yarways, see a nearby industrial distributor . . . 216 stock and sell Yarways.

YARNALL-WARING COMPANY, 100 Mermaid Ave., Philadelphia 18, Pa.

FREE TRAP SELECTOR

It's important to have the right trap in the right place. New 20-page selector tells quickly and easily which *is* the right Yarway trap for any application. Write for your free copy.

YARWAY

the steam trap

designed with more production in mind

Power

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...with Power readers...

CORKING COVER . . .

I've heard long low whistles for covers with pretty girls on them—and now I've heard them for a power-plant cover. That painting of Sunbury on the March issue certainly was a corker.

I'm surprised to find engineering editors traveling in "art" circles as you must have been to spot that painting. The result was one of the best magazine covers I've seen, so your efforts were worthwhile.

Cincinnati, Ohio — J J MACBRIDIE

We don't usually travel in art circles as Reader MacBridie softly impeaches. But on the basis of a short whirl at it, we're ready for more.

Editorial Assistant Althea Schaffer comes from down Pennsylvania way, heard of the PP&L exhibit on a visit home. Her tip, way back last fall, sent Executive Editor Lou Rowley and Art Editor Charlie Marschalek on a quick run down to Bethlehem, where the paintings were on display. They liked what they saw, came back with several possibilities for outstanding color covers. You've seen the first—watch for others.—ED.

ANOTHER ASPIRIN . . .

I'd like to make some suggestions about Case No. 7 of the "Could You Cure This

(*Continued on page* 210)

...lines and bylines

Hicks, Powell, Rowley and pictures

PIPE DREAM THAT CAME TRUE aptly describes this month's lead story (p 73). It began about two years ago. Dawson Powell, technical editor for Grinnell Company, Inc, wondered if many power men knew the "blood, sweat and tears" behind an innocent-looking piece of h-p h-t piping. Executive Editor Lou Rowley said, "Why not tell them?" And suggested doing it by a photo record of an actual job.

Powell agreed, picked the Salem Harbor job as guinea pig. In the next year he piled up some 4000 miles of sleeper jumps, keeping tabs on job progress from ingot to installation. And he had over 100 choice pictures telling an exciting story. Then Lou Rowley and Ty Hicks pitched in: comparing picture values, planning meaningful sequences, editing telling captions. The result is a unique story, the kind that makes topnotch technical journalism topnotch fun.

D M Given

SMALL PLANTS miss a lot of bets to cut costs with modern coal- and ash-handling equipment. That's why the article on p 86 (first of two) rates so high in timely interest.

Don Given, its author, has just wound up his part of extensive research on this subject carried out by Fairmont Coal Bureau. He swung into fuel engineering there after work at Battelle Memorial Institute.

A BME graduate (Ohio State, 1924), Don had just got a foothold in engineering with Sperry Gyroscope Co when the Navy called him to officer duty, which lasted more than two years. Now an apartment dweller in New York, he's had to forego earlier hobbies, devotes much of his spare time to church work.

Ray McBrian

RAILROADERS are intensely practical people and Ray McBrian is no exception. On his way up the line with Denver & Rio Grande Western, Ray has learned a lot about motive power.

Now, as engineer of standards and research, he's known nationally as an authority on diesels, particularly diesel lubrication. This can be a rough problem for the railroaders and they've done a lot of work on it.

With plenty of engines on the road piling up plenty of service, Ray has picked up experience fast. Out of all this comes know-how that operators of stationary diesels can put to work. Take a look at what Ray's story on lube-oil ash reveals (p 112), see if there aren't some slants there for you.

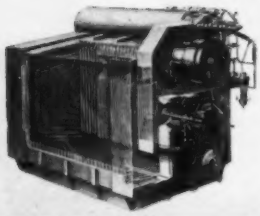
191 MILLION LB/HR ENDORSEMENT

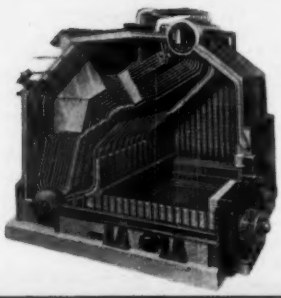
...of B&W Integral-Furnace Boilers

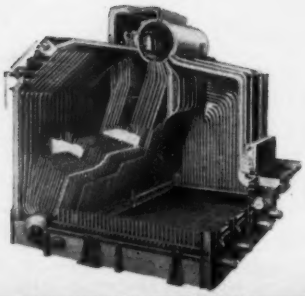
COST SAVING FEATURES

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings even with high boiler water concentrations
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

FOR STEAM







TYPE FM	TYPE FF	TYPE FJ
2,800-28,000 lb/hr	8,000-50,000 lb/hr	30,000-70,000 lb/hr
up to 250 psi	up to 600 psi	up to 800 psi
Oil and Gas Firing	Stoker, Oil and Gas Firing	Stoker, Oil and Gas

Examples of B&W Engineering For Economy

Year after year, B&W Integral-Furnace Boilers have been the leading choice of an ever wider variety of industrial and other users. This trend to B&W has been consistent . . . during the past year alone, orders for B&W Integral-Furnace Boilers amounting to almost 22,000,000 lb per hour of steam capacity have brought the total—in service and on order—to 191,000,000 lb per hour. This sweeping acceptance by users is the strongest possible endorsement of B&W dependability and economy. Today, B&W Integral-Furnace Boilers of every type and rating, covering an unusual range of steam requirements, are *service proved . . . your proof* of lower steam costs combined with higher service life when you choose B&W. And should your conditions demand a special design for the consumption of unlisted fuels, B&W can meet your requirements.

Before planning your next installation, check which B&W Integral-Furnace Boiler best covers your specific needs. Write for bulletins covering any one or all of the boilers shown. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

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Rubber
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Gas Companies
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Others

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Navy Yards
Office Buildings
Ordnance Plants
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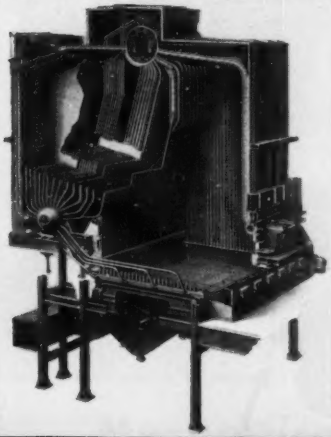
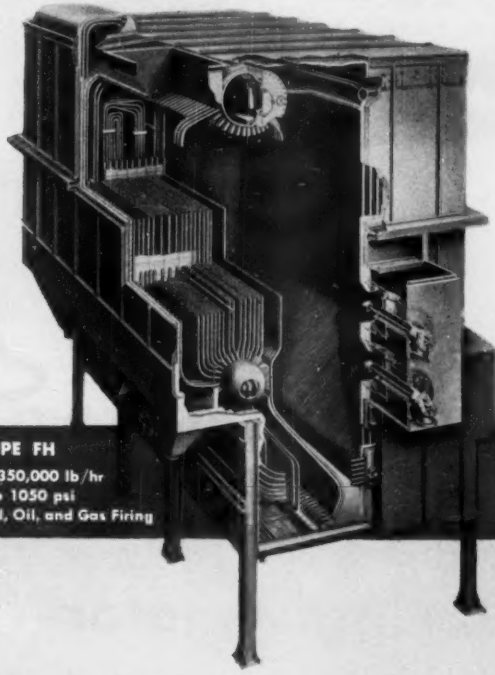
REQUIREMENTS FROM 2800 TO 350,000 LB/HR





TYPE FL
60,000-150,000 lb/hr
up to 1050 psi
Stoker, Oil and Gas Firing

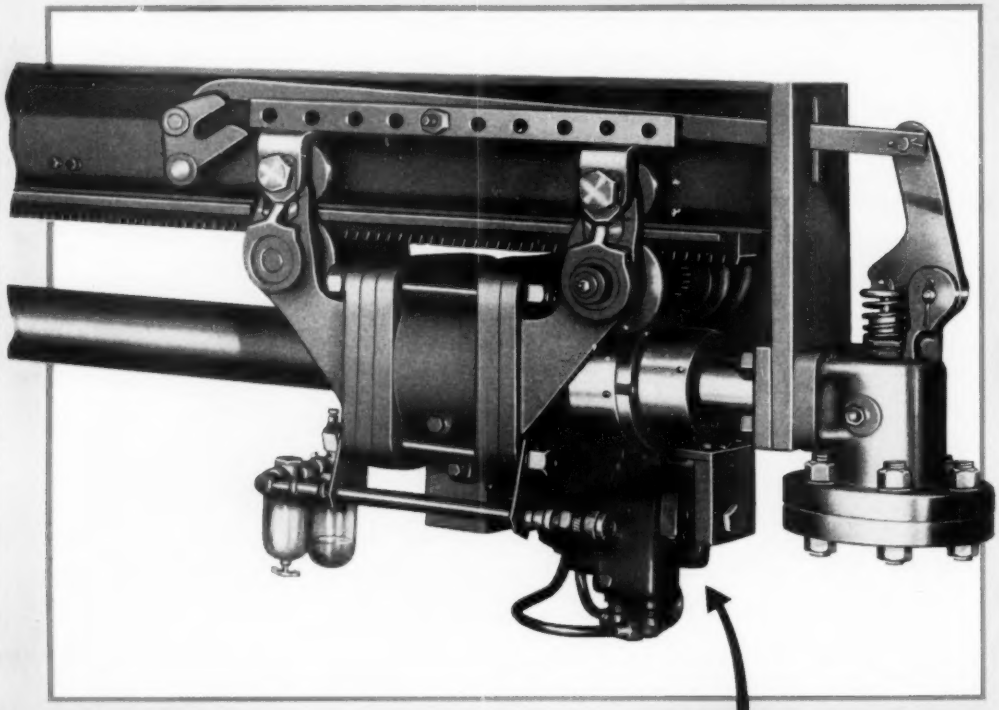
TYPE FH
50,000-350,000 lb/hr
up to 1050 psi
Pulverized Coal, Oil, and Gas Firing

B&W

BABCOCK & WILCOX

G-5467

Single Motor Drive



A single motor (air or electric) both rotates and propels the long lance tube

Another important advantage of

DIAMOND Model IK Long Retracting Blowers

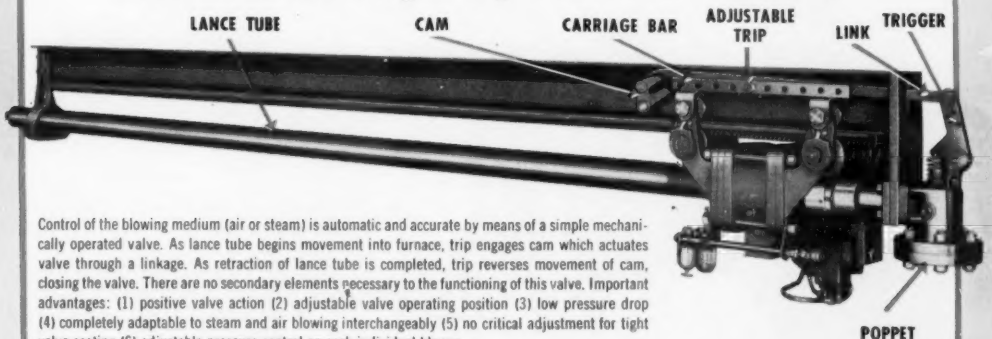
A single motor, simultaneously propelling the carriage and rotating the lance tube, through a rugged system of gears, represents the ultimate in simplicity and reliability. There is only one set of motor elements, one set of control elements, and one set of power supply facilities to operate and to maintain. This feature of the Model IK Blower is an excellent example of the Diamond policy of simplification that means more dependable operation and lower maintenance costs. Another feature of the Model IK that has the enthusiastic approval of users is the mechanically operated valve (see below). Opening and closing of the valve is positive, dependable and accurate . . . all essential to correct performance. Here again note the simplicity of the mechanism. For further information, ask for a copy of Bulletin 1055.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario

Mechanically Operated Valve

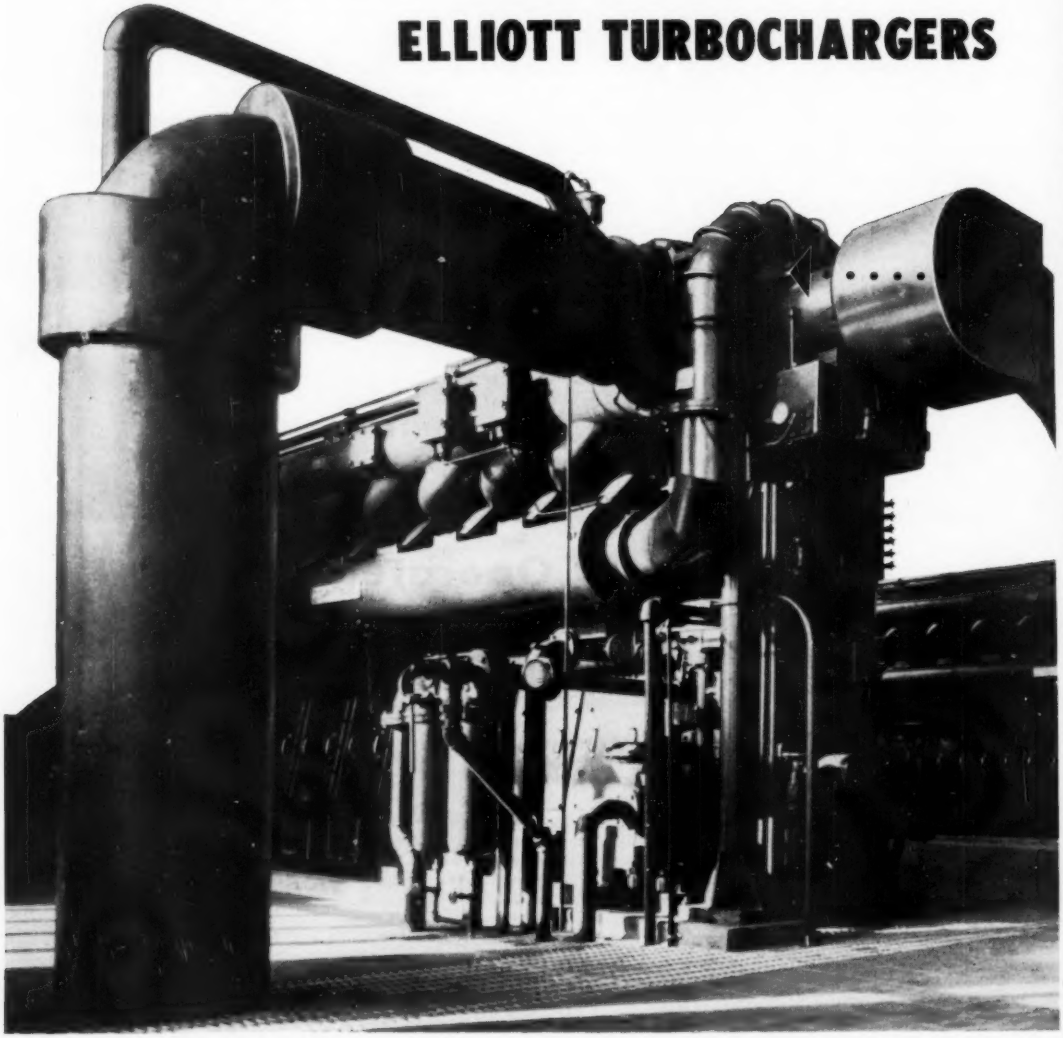


Control of the blowing medium (air or steam) is automatic and accurate by means of a simple mechanically operated valve. As lance tube begins movement into furnace, trip engages cam which actuates valve through a linkage. As retraction of lance tube is completed, trip reverses movement of cam, closing the valve. There are no secondary elements necessary to the functioning of this valve. Important advantages: (1) positive valve action (2) adjustable valve operating position (3) low pressure drop (4) completely adaptable to steam and air blowing interchangeably (5) no critical adjustment for tight valve seating (6) adjustable pressure control on each individual blower.

Diesel economy

The six dual-fuel diesels in New York's new sewage treatment plant, are equipped with...

ELLIOTT TURBOCHARGERS



begins here

● Designed for the ultimate in operating economy, the new beautifully appointed Owl's Head (New York City) sewage treatment station utilizes by-product sewage gas for diesel fuel, plus oil as needed only when pumping conditions impose peak loads, as in the case of heavy rainfall.

To further insure maximum savings the advantages of Elliott turbochargers are realized to the full, in their application to each engine. These advantages, as demonstrated in many hundreds of installations, include:

- Engine output increased up to 100%
- Increased overload capacity
- Constant torque at reduced speeds
- Reduced consumption of fuel and lube oil
- Turbocharger operation unaffected by reversing engine.

THE LATEST DEVELOPMENT IN TURBOCHARGING is the Elliott high-pressure type, illustrated above, for blower pressures to 20 psi, permitting 170 bmep (and more) in the cylinders. Built in sizes for four-cycle engines up to 3500 hp.

For full data phone or write your nearest Elliott district office.

ELLIOTT Company

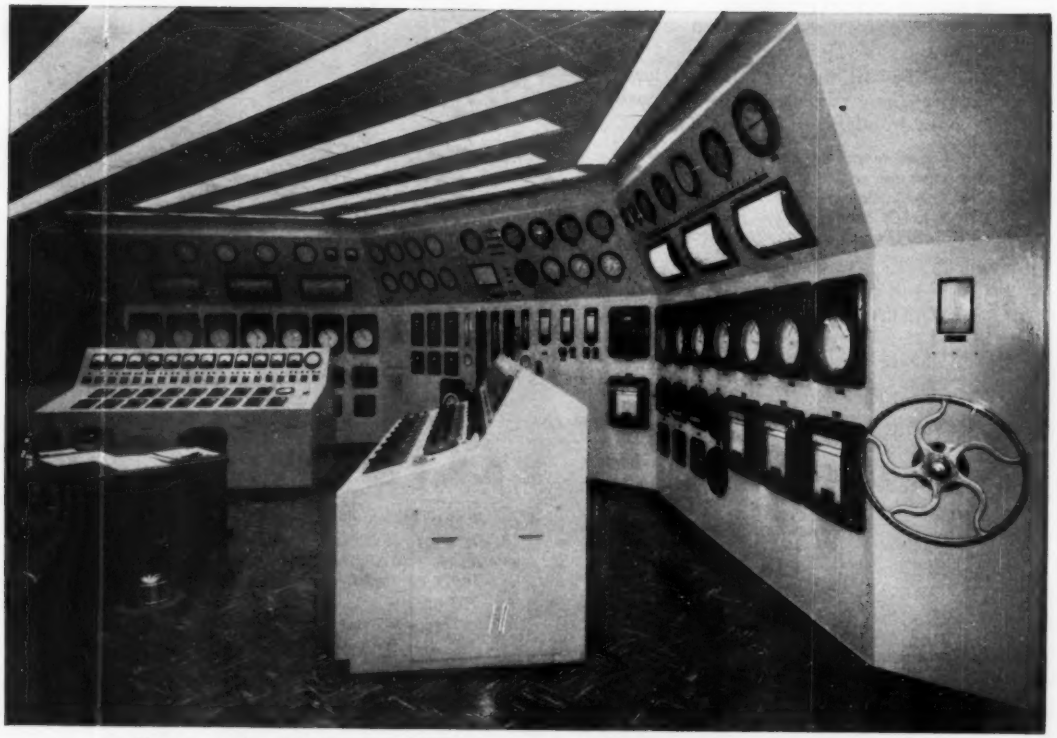
Supercharger Dept., Jeannette, Pa.

PLANTS AT: JEANNETTE, PA. • RIDGWAY, PA. AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

Engine room of the Owl's Head Station, designed for maximum operating economy. Features six Superior 1300-hp, 327-rpm, 8-cylinder dual-fuel diesels, equipped with Elliott turbochargers.

M2-2

What's YOUR Fuel-dollar



This Centralized Boiler Control Room insures high efficiency in the use of Fuel-dollars at the Mustang Station of Oklahoma Gas and Electric Company. It includes Bailey Meter Combustion Control, Bailey Three-Element Feed Water Control, Bailey Steam Temperature Control, and Bailey Feed Water Pump Recirculating Control for two gas-fired boilers.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Efficiency ?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY, LIMITED • MONTREAL, CANADA

Here's the AUTOMATIC *at* PALATKA *of* FLORIDA POWER &

Effective boiler cleaning and low cleaning costs were demanded for the new Palatka Steam Electric Station of Florida Power & Light Company. Vulcan will deliver these benefits.

Effective boiler cleaning will be a simple matter of pushing a single button to start operation of the automatic-sequential soot blowing system. Each blower will work in the correct sequence, applying the right amount of steam at the velocity needed for thorough cleaning.

Steam will be saved, because each blower will operate for exactly the correct time. Labor will be saved, because operators will not need to climb to remote locations when they blow soot. Maintenance costs will be low, because each Vulcan unit is designed and built for easy inspection and repair or replacement, if needed.

Vulcan Automatic-Sequential Soot Blowing is described in Bulletin 483. Write for it. Learn how you can profit from advanced Vulcan designs.

Standing at the central control panel, the operator will need only push a single button to start the automatic sequence. He can see at a glance that each blower operates in correct sequence, cutting in automatically to blow for the right length of time with the required steam flow and pressure. He can skip or repeat operation of individual blowers as needed without leaving the panel.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DU BOIS, PENNSYLVANIA

VULCAN *Automatic*

VULCAN

SEQUENTIAL SOOT BLOWING SYSTEM

STATION

LIGHT COMPANY

Boiler by.....Combustion Engineering—Superheater, Inc.

•

Type of Boiler.....VUX

•

Capacity. 350,000 lb per hr

•

Operating Pressure. 850 psi

•

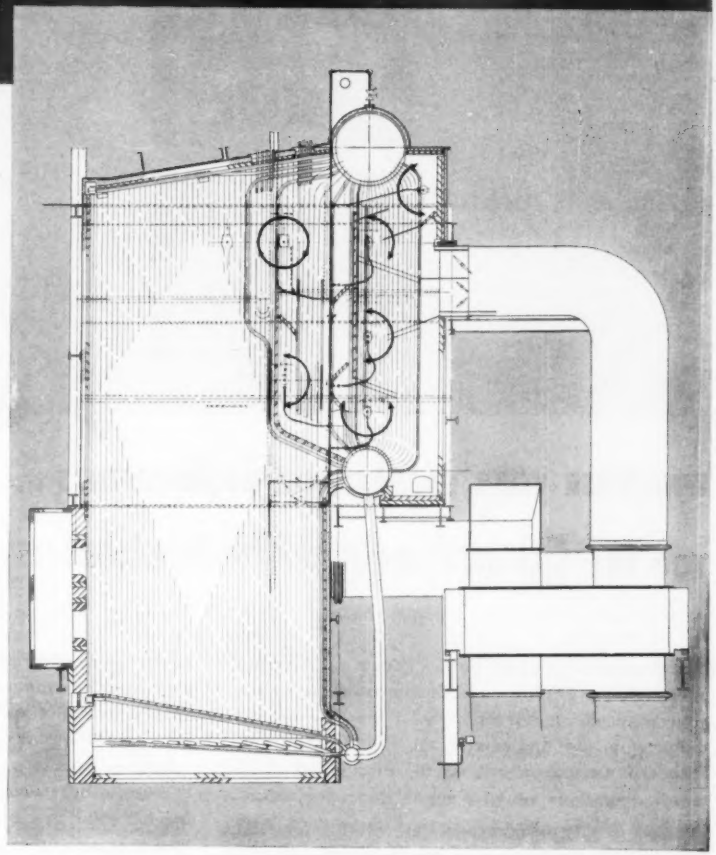
Total Steam Temperature .....900° F

•

Fired with.....Oil, with provision for future use of coal

•

Consulting Engineers..... Ebasco Services, Incorporated



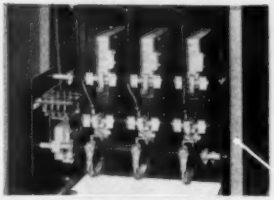
The Vulcan Soot Blower System includes two long retractable blowers and ten VULcomatic rotary units, air-powered, under full automatic-sequential control. Blowing medium is steam taken from the saturated drum and reduced to 600 psi without a relief valve.

YOU CAN BE **SURE**.. IF IT'S

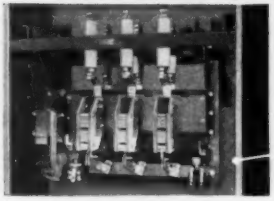
Westinghouse

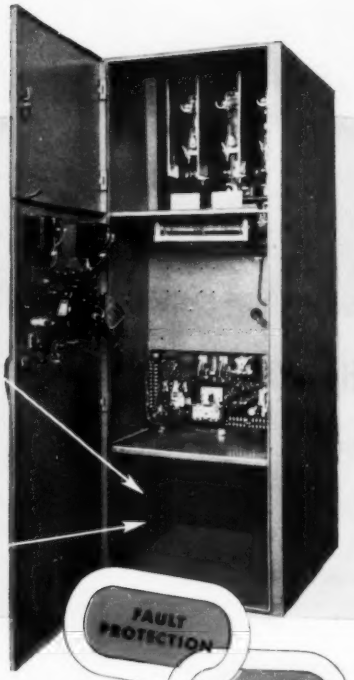
WESTINGHOUSE HIGH-VOLTAGE COMBINATION STARTER

Air-break Contactor for tough repetitive duty. Elimination of oil and tank cuts maintenance and inspection costs.



Oil-immersed Contactor for normal starting duty or where corrosive atmospheres, extreme dust and dirt, or excessive moisture are prevalent.





WHATEVER YOUR OPERATIONAL REQUIREMENTS . . .

YOU GET Co-ordinated Protection

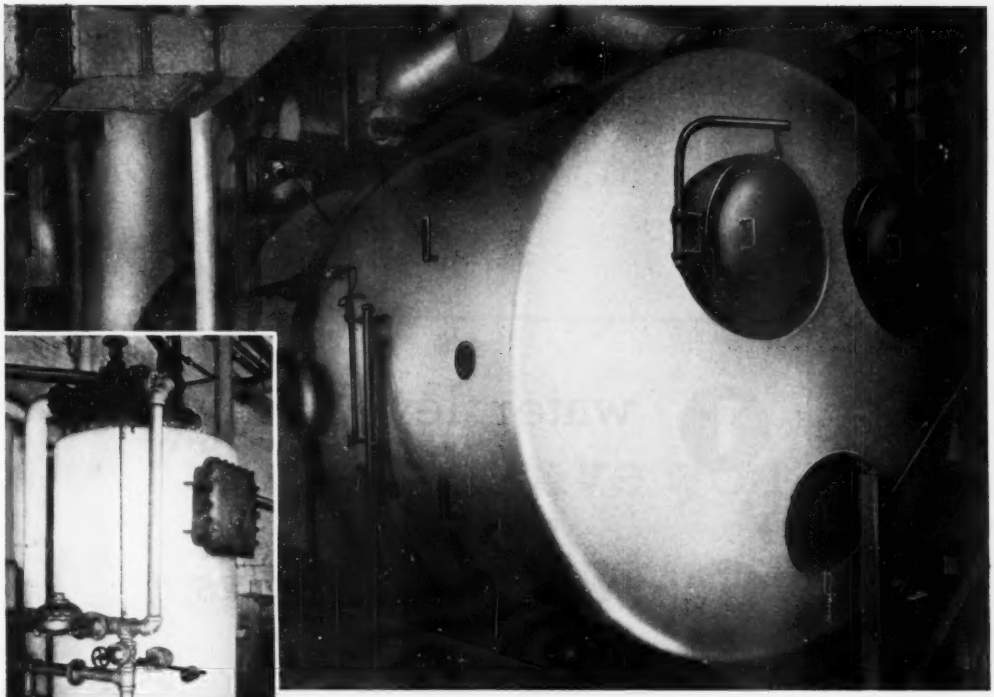
Ten times an hour or ten times a minute . . . there is a Westinghouse High-voltage Combination Starter for your particular motor operation cycle. For normal motor stop, start and reverse, the Type DN-OH Oil-immersed Contactor will do the job. Where these motor operations are of a highly repetitive nature, the Type AH Air-break Contactor is the answer. With both types you get co-ordinated protection . . . in a single, self-contained unit.

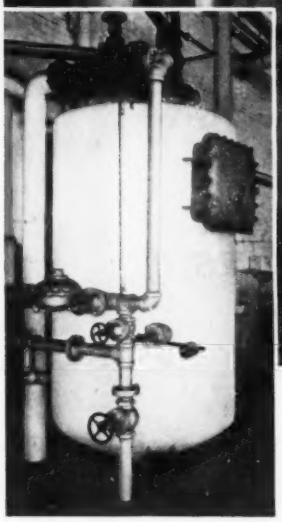
Westinghouse Co-ordinated Protection is three-dimensional and interlinked . . . guards circuits, motors and personnel. Type BAL Fuses provide short-circuit protection—act as convenient disconnects. Magnetic Contactor controls motor—thermal relays supply overload protection. Sectionalized steel cabinets protect personnel and equipment. Each link is of equal importance and together they add up to complete protection for men, motors and equipment.

Further details are covered in booklet B-4673 "Co-ordinated Protection"—available from your local Westinghouse representative or direct from Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27004

Westinghouse

HIGH VOLTAGE STARTERS





A Big Help

on small—as well as big—deaeration jobs

Small deaerators are big business at Worthington! That's why the plant with small-capacity requirements will benefit by getting acquainted with the complete range of Worthington deaerating equipment.

Worthington Gives You All Types, All Sizes

Worthington deaerating heaters and deaerators are built in sizes to handle from a few thousand pounds an hour to over a million. They are tailor-made to fit the particular requirements of each job. Special designs are available for operation with scale-forming water.

Both tray and steam-jet types are made—with external surface-type vent condensers or internal direct-contact vent condensing. They can be furnished for any practical operating pressure—constant or variable—or for vacuum operation.

With a complete range of sizes and types at their fingertips, Worthington engineers can competently recommend the design best suited to *your* requirements.

Remember, too, Worthington designs are backed by over 50 years experience in the design and manufacture of direct contact feedwater heaters and over 100 years experience in hydraulic machinery.

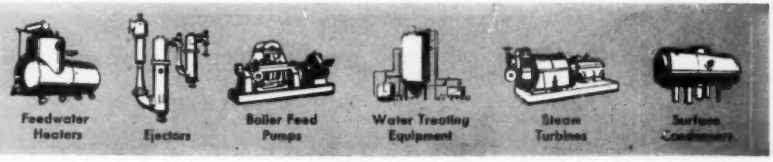
Send your water treating problem to Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

WORTHINGTON

DEAERATORS

S.1.5

A GREAT TEAM IN STEAM



No matter... how many control influences on your

1. water level only

or

2. water level *plus* steam flow

or

3. water level *plus* steam flow *plus* feed water flow

NORTHERN EQUIPMENT DIVISION
CONTINENTAL FOUNDRY

COPES

BOILER FEED

you prefer

Boiler Feed Water Regulators . . . . . .

COPES will give you correct feed and close level control—without depending on any other instruments.

. . . . . ERIE, PENNSYLVANIA
& MACHINE COMPANY

WATER REGULATION

Meeting a tight

New York's largest

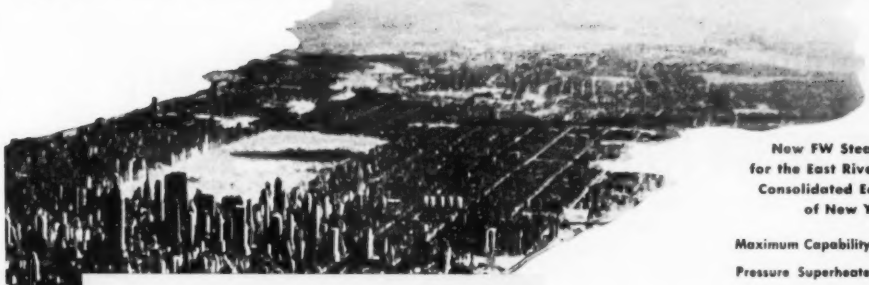
STEAM GENERATOR

a 1,450,000 lb per hr FOSTER WHEELER

New York is perennially "bursting at the seams"—but there is always a way to accommodate additional development. This is made possible by wise city planning and the far-sighted policy of the Consolidated Edison Company of New York, Inc. which keeps ahead of New York's ever-growing demand for electricity. The new Foster Wheeler Steam Generator now being constructed for the East River Station of the Consolidated Edison Company is a contemporary example of how one organization seeks to anticipate the needs of future populations.

FOSTER WHEELER CORPORATION • 165

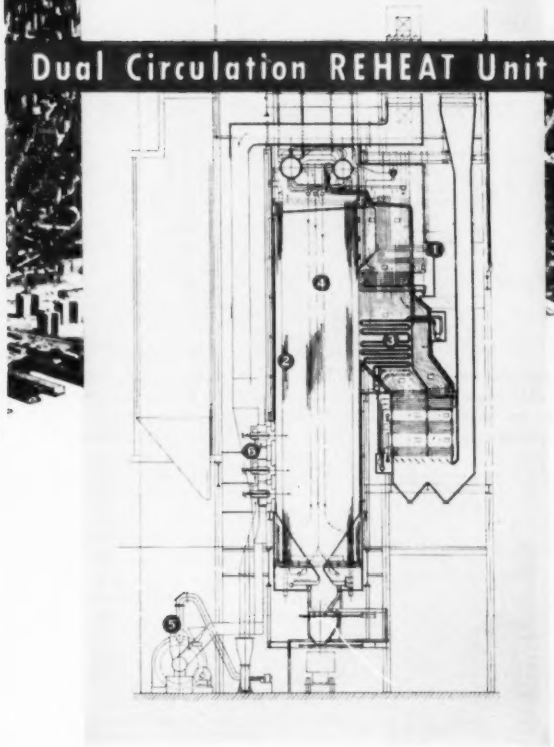
situation

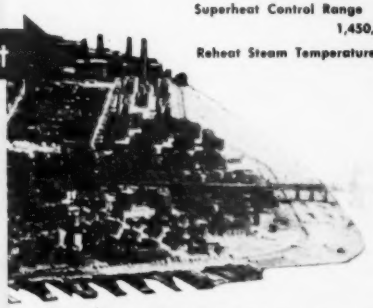


New FW Steam Generator for the East River Station of the Consolidated Edison Company of New York, Inc.

Maximum Capability	1,450,000 lb per hr
Pressure Superheater Outlet	1850 psig
Primary Steam Temperature	1000 F
Superheat Control Range	325,000 to 1,450,000 lb per hr
Reheat Steam Temperature	1000 F

Dual Circulation REHEAT Unit





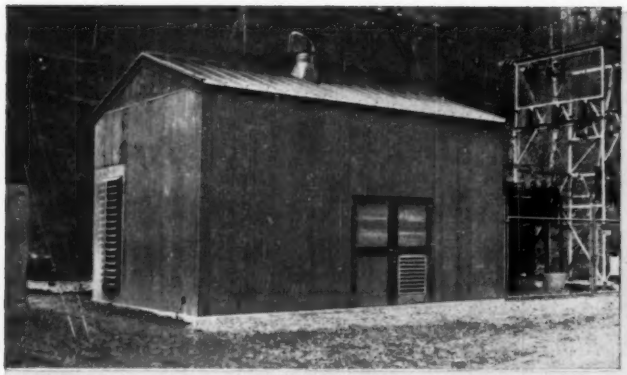
1. **STEAM OF SUPER PURITY**—Application of dual circulation principle produces steam of lowest contamination especially silica.
2. **RADIANT SUPERHEATER**—in combination with convection superheater enables attainment of full primary steam temperature from 25% to full load.
3. **CONVECTION REHEATER**—Location in low temperature zone after convection superheater provides protection against all variables in operation.
4. **CONSERVATIVE FURNACE**—Low heat absorption rates per unit area and low furnace exit gas temperatures.
5. **FOSTER WHEELER BALL MILLS**—High availability, low maintenance and sustained fineness of pulverization.
6. **FOSTER WHEELER TURBULENT BURNERS**—Turbulent action of air and fuel produces uniform mixture for complete combustion and even heat distribution.

BROADWAY, NEW YORK 6, N. Y.

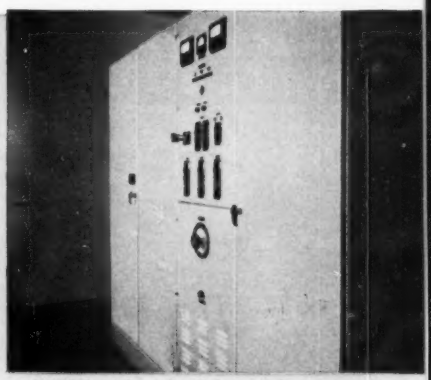
FOSTER WHEELER

Whether Mine . . .

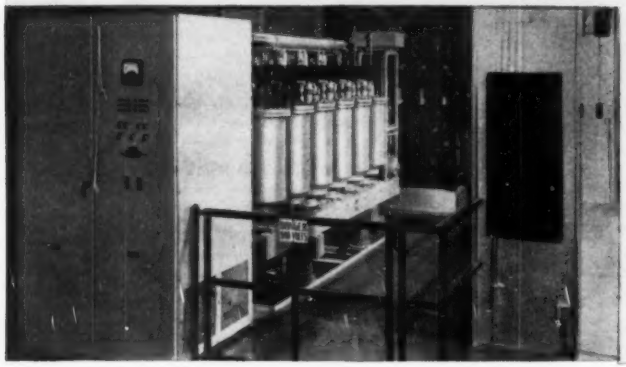
ALLIS-CHALMERS MERCURY ARC RECTIFIERS WITH EXCLUSIVE DESIGN FEATURES CAN SUPPLY YOUR DC NEEDS



OUTSIDE view of one of five Allis-Chalmers rectifier substations serving the haulage system of a coal mining operation. Transmission line enters building at right, dc leaves at left. Entire substation can be moved as coal seams are exhausted, leaving only concrete slab behind.



INSIDE is the "dead front," factory packaged, 500 kw, 275 volt dc, sealed tube rectifier. Compartments are (L to R): for rectifier tubes, firing and auxiliary control, dc cathode breaker.



PUMP evacuated rectifiers are applied in heavy duty service from 750 kw up. The 3400 kw, 500 volt unit seen here operates in parallel with steam turbine driven dc generators in the electrolytic reduction of metal.

SIDE view of pump evacuated rectifier at left, showing the centralized placement of auxiliaries — exclusively Allis-Chalmers. Both evacuation equipment and heat exchanger are accessibly placed at one end.

ALLIS-CHALMERS

Allis-Chalmers Engineers Introduced Mercury Arc Rectifiers to U.S. Industry

. . . or Mill!

ALLIS-CHALMERS
MERCURY ARC RECTIFIERS

WHEREVER DC IS NEEDED, from the mine to the mill, from the Elevated to the elevator, Allis-Chalmers rectifiers are quietly working away.

They combine the high efficiency, low maintenance characteristics of the mercury arc rectifier with exclusive A-C refinements in design and construction.

Factory packaged, light in weight, and requiring no special foundation, they can be placed right at the load center to cut dc feeder losses. Conversion efficiency is higher at all loads with large power savings during light load periods.

And in addition, only from Allis-Chalmers can you get rectifiers with these exclusive design refinements:

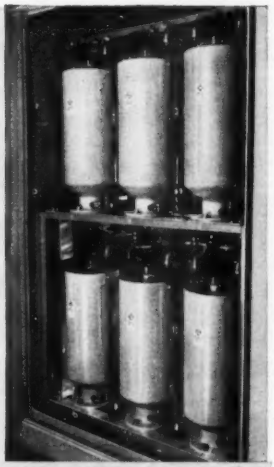
EXCLUSIVE ALLIS-CHALMERS FEATURES

- **Fixed excitation anode** — doesn't contact mercury and is independent of level, turbulence or impurities . . . requiring no adjustment, maintenance or replacement.
- **Continuous excitation** — pilot arc always present, eliminating need for continuous and synchronized re-ignition. Rectifier will ride through severe ac voltage disturbances.
- **Grid phase control** — in cooler and cleaner region near anode, where ion density is lowest.
- **Internal cooling system** — high heat transfer with seamless tube cooling coil located within the rectifier.
- **Arcover-free tank** — eliminates danger of arcing-over to tank by insulating entire arc path.
- **Enamelled anode seals** — multi-layer fused vitreous construction provides high-strength seal, unaffected by thermal variation.

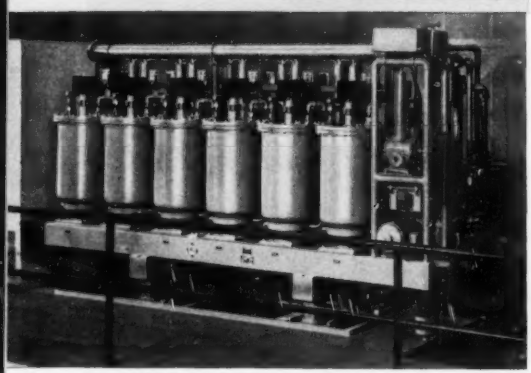
All these design advances are obtainable *only* from Allis-Chalmers. When you consider mercury arc rectifiers in your expansion or modernization planning, consider Allis-Chalmers.

For help with rectifier application and a fuller explanation of exclusive superior features, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3681



MODERN Allis-Chalmers design sealed tubes are located in the tube compartment. Other sealed tube units are supplied in ratings from 200 to 1000 kw.



10 Mercury Arc Rectifier Advantages:-

★ Compact and light weight ★ No special foundation ★ Push button starting with no synchronizing ★ Quiet operation with high power factor ★ Low idling loss and high conversion efficiency ★ High momentary overload capacity ★ Immunity to frequent short circuits ★ No moving parts, contributing to low maintenance cost ★ No attendance needed during operation ★ Resistant to dust, moisture, fumes ★ Simple construction with long life

A-C ALLIS-CHALMERS

HERE *are* INSIDE ...KVS

PULVERIZED COAL *for* FULL CAPACITY *on* INSTANT DEMAND

LOW OPERATING *and* MAINTENANCE COSTS

UNBURNT CARBON LOSSES LESS THAN ½%

HANDLES BITUMINOUS, ANTHRACITE *and* COKE BREEZE

REMOVES MOISTURE WHILE PULVERIZING

NO SHUTDOWN FOR ADDING BALLS

COAL REDUCED TO SUPERFINENESS

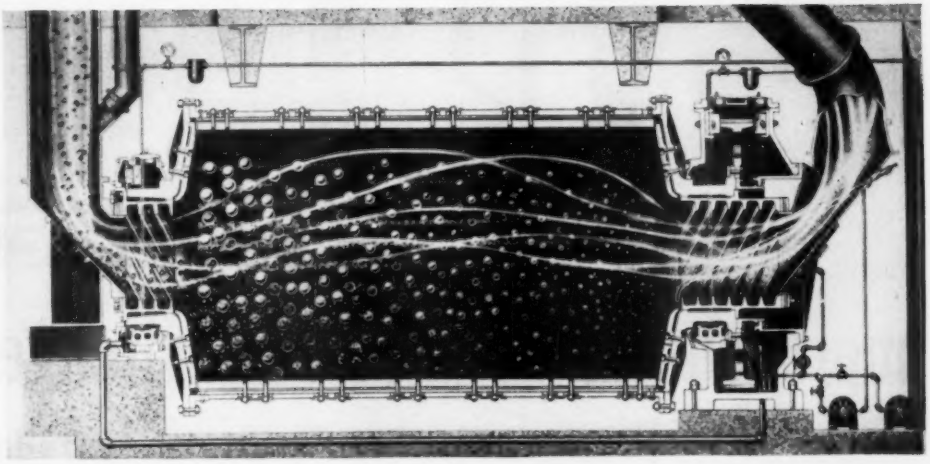
FUEL COMPLETELY CARBURETED, READY *for* COMBUSTION

INSTANT RESPONSE TO CONTROLS

ALL GRADES OF COAL PREPARED

FACTS *on...*

AIR SWEPT TUBE MILLS



Air passing through the mill floats out superfine, carbureted fuel.

Preheated air in desired quantities is drawn through the mill by a variable speed fan, removing only the impalpable powder, automatically controlling fineness of pulverization.

Coal is ground in air and collected by air. Oxygen and carbon combine to provide, in effect, a highly combustible gas for delivery to the combustion chamber.

Moisture in the coal is released by hot air passing through the mill. Coal containing from 15% to 20% moisture is fired without the use of a separate dryer, directly from the mill without storage in bins or hoppers.

No magnetic separator is used. Tramp iron cannot damage KVS Air Swept Tube Mills but instead acts as grist and actually helps grind coal in the same manner as the Herculite balls.

KVS ENGINEERING SERVICE

KVS is equipped to design and build complete power plants from "bunker to bus bar" in any part of the World and assume full responsibility for overall performance guarantees whether or not the equipment is built in KVS shops.

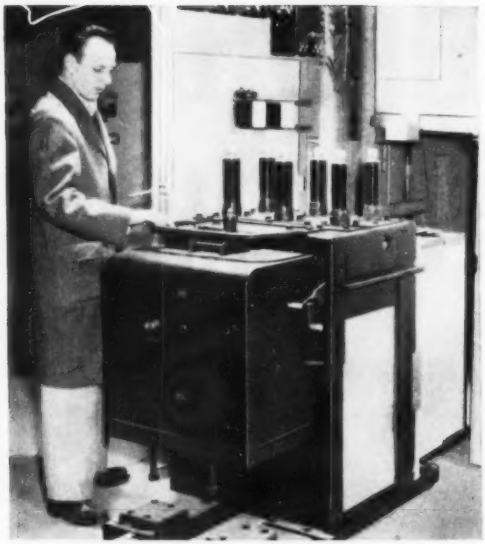
Kennedy Products — Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

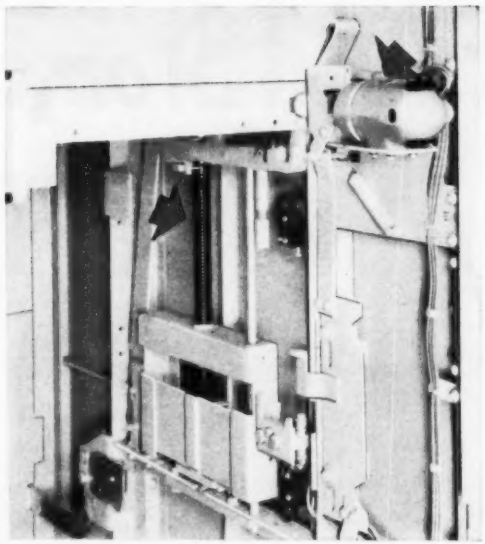
2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA



REMOVABLE MAGNE-BLAST CIRCUIT BREAKER features improved flame-retardant insulation and simplified contact design. Breaker operating mechanism and control relay are on the front of breaker for easy accessibility.



NEW FASTER ACTING BREAKER ELEVATING MECHANISM can raise the removable circuit breaker into position, or lower it for testing, in 30 seconds. A new compact gear-motor drives the simplified jack screw elevating mechanism.

Improved G-E Metal-clad Switchgear

- - - - - - - STRONGER! SAFER! matched to today's demands for more dependable power for increased production

With fast-moving production schedules calling for more and more electric power, General Electric's improved Metal-clad Switchgear, in 4.16 kv and 13.8 kv ratings, answers the need for even greater power circuit protection and freedom from electrical shut-downs.

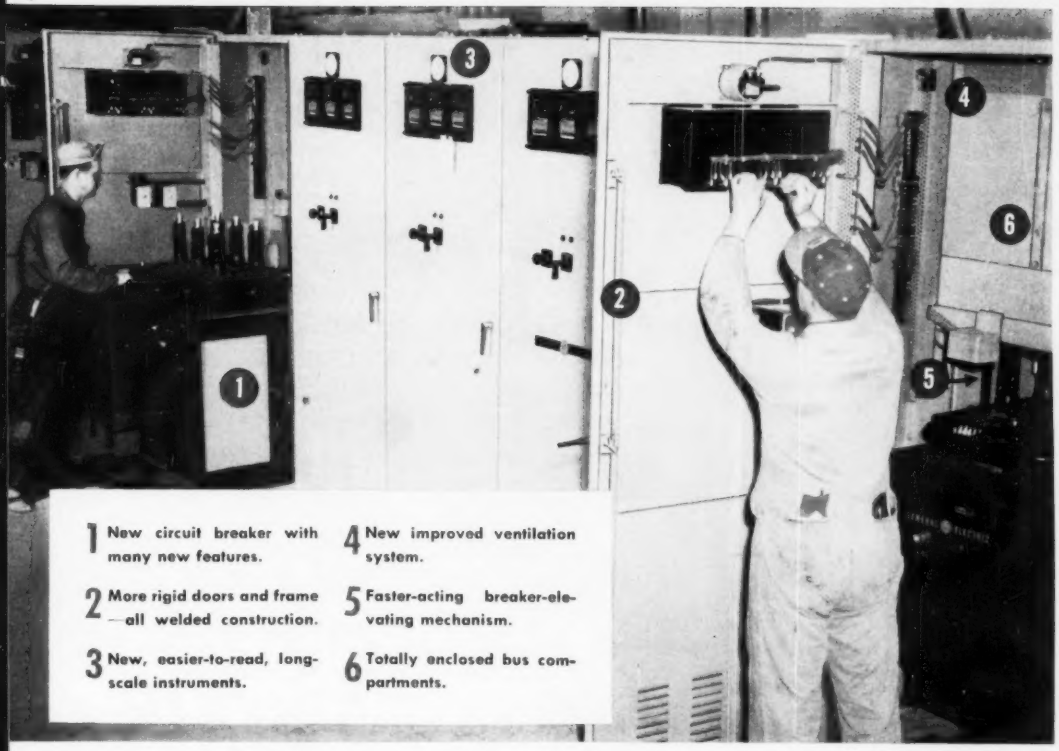
Retaining all the basic advantages pioneered in earlier G-E Metal-clad Switchgear and meeting all industry standards, this improved equipment offers a wealth of pace-setting design refinements. New features simplify operation and inspection and provide increased safety for personnel. And with stronger, more rigid construction and simplified design of many components, you get even more dependability.

Look over the typical improvements shown here. Then get the complete story from your local G-E Apparatus Sales Office, or write to General Electric Company, Schenectady 5, N. Y.

Complete data at your fingertips. Write for these helpful bulletins

Full information on modernizing or expanding your electrical system with G-E packaged equipment is given in these three illustrated booklets. Write for GEA-5664 "G-E Metal-clad Switchgear," GEA-3592 "Load-center Unit Substations," and GEA-5600 "Power for Industry's Third and Biggest Expansion."

GENERAL ELECTRIC



1 New circuit breaker with many new features.

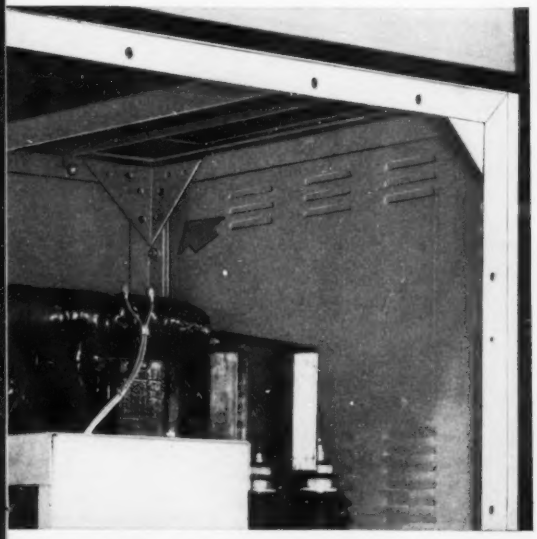
2 More rigid doors and frame—all welded construction.

3 New, easier-to-read, long-scale instruments.

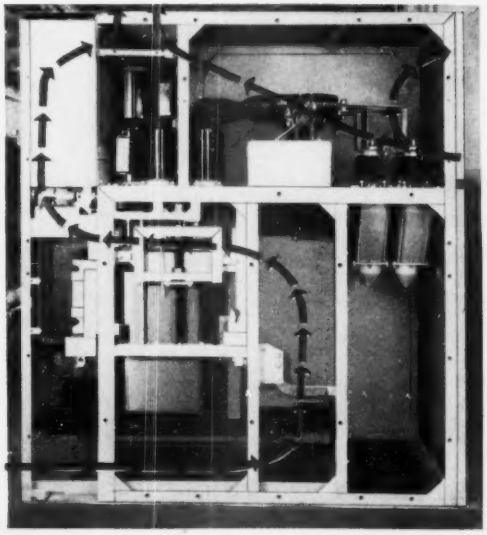
4 New improved ventilation system.

5 Faster-acting breaker-elevating mechanism.

6 Totally enclosed bus compartments.



FRAME NOW COMPLETELY WELDED into one solid unit. Gusseted corners (see arrow) provide greater rigidity. Doors have a three-point latch operated from a single handle, and are reinforced against warping by a steel tube at hinge side.



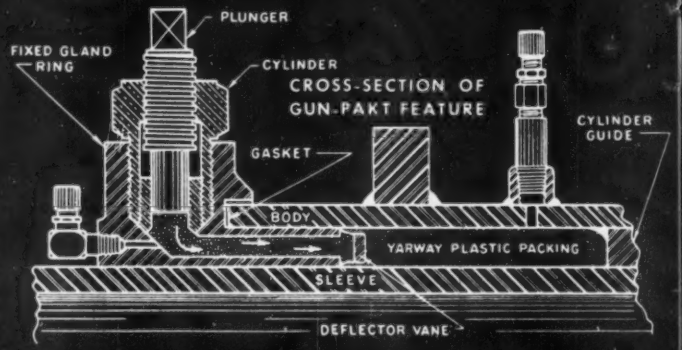
IMPROVED VENTILATING SYSTEM: Arrows show natural draft of air that constantly ventilates entire switchgear unit. The totally enclosed bus compartment, at upper left, is cooled by circulation of air around it.

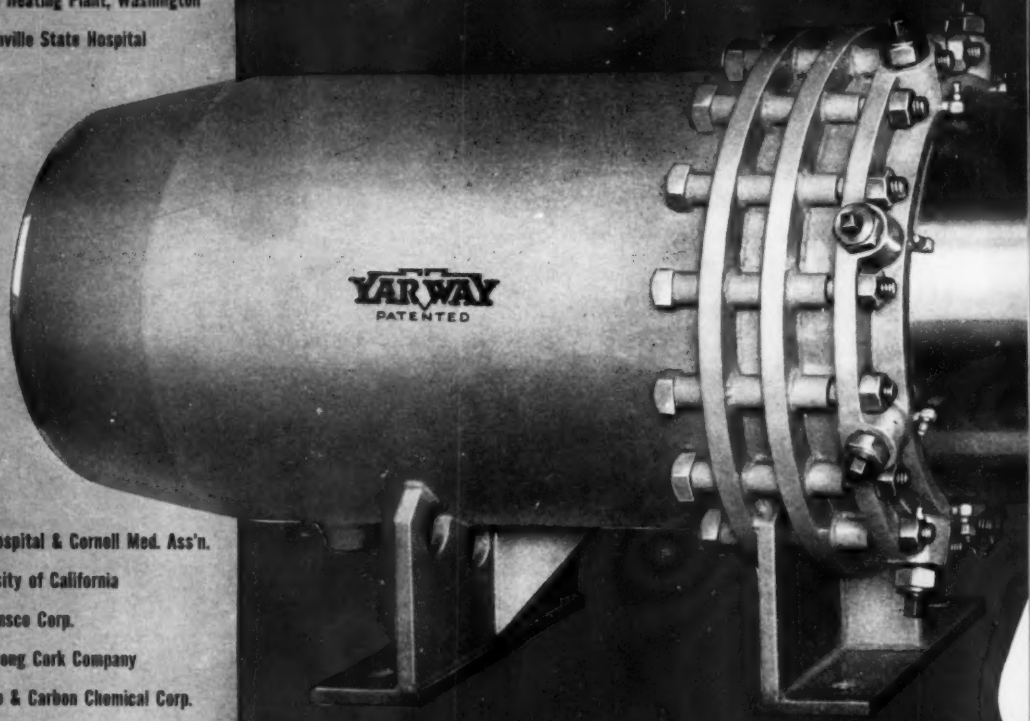
TYPICAL USERS

Alleghany Co. Steam Heating Company
Sanitary District of Chicago
City of Cleveland
Florida Power & Light Company
Georgia Power Company
Philadelphia Electric Company
Dayton Power & Light Company
Camarillo (Cal.) State Hospital
Central Heating Plant, Washington
Jacksonville State Hospital

N.Y. Hospital & Cornell Med. Ass'n.
University of California
Agfa Ansco Corp.
Armstrong Cork Company
Carbide & Carbon Chemical Corp.
Chrysler Corp.
General Motors Corp. (Buick Div.)
General Motors Corp. (Chevrolet Div.)
Westinghouse Electric Co.
West Central Heating Plant, Wash., D.C.
University of Washington
Public Service Company of Colorado

this expansion joint o





YARWAY

FREEDOM

FROM SHUTDOWNS

What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

Yes, they're all important. But when you're dealing with steam under pressure, *there's nothing more important than reliability—freedom from shutdowns.*

The high factor of safety in Yarway Gun-Pakt Expansion Joints prevents shutdown losses—eliminates accident hazards.

Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.

Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

FEWER JOINTS NEEDED

With Yarway Gun-Pakt Joints you need fewer joints per length of pipe line. Each sliding sleeve may have a traverse of either 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

Gun-Pakt is more than just another expansion joint—it is a revolutionary idea in expansion joint engineer... success is shown by wide use in lead... stations, institutions and ...

Get ... Gun-Pakt story . . . 1912. Write to ...

YARNALL-WARING CO.

...

GUN-PAKT EXPANSION JOINT

SWITCHGEAR DEPENDABILITY BEGINS

15,000 TO 100,000 AMPERES INTERRUPTING

600 VOLTS A-C, 250 VOLTS D-C

TO 6,000 AMPERES CONTINUOUS A-C OR D-C,
TO 10,000 AMPERES CONTINUOUS D-C ONLY

INDOOR AND OUTDOOR EQUIPMENT

When you buy low-voltage switchgear you buy protection for personnel and equipment. Protection against costly production loss if power should be interrupted by a "nuisance" overload. Protection against the expense of ruined equipment, spoiled processes, and the ravages of fire resulting from a short circuit. Only *circuit breakers* can provide this type of protection!

And to those fully familiar with *difficult* circuit protection problems, *circuit breaker* means *I-T-E*. The history of low-voltage-circuit protection parallels the development of I-T-E circuit breakers.

I-T-E Low-Voltage Switchgear takes advantage of every feature of I-T-E circuit breakers. Thus, it provides users with required protection and safety—along with bonuses of convenience and neat appearance. By specifying I-T-E Low-Voltage Switchgear, you know you have specified the finest circuit breaker.

You can get the complete story on I-T-E Low-Voltage Switchgear by writing for Catalog Section 6004. The I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pennsylvania.

◀ Multumite "600" Construction for Types KA, KB, KC and LG drawout air circuit breakers—the combination for complete protection of low-voltage lighting, power, and distribution circuits.

I-T-E

LOW-VOLTAGE

I-T-E CIRCUIT BREAKER COMPANY • 19TH AND HAMILTON STREETS • PHILADELPHIA 30, PA.

WITH CIRCUIT BREAKER PROTECTION!

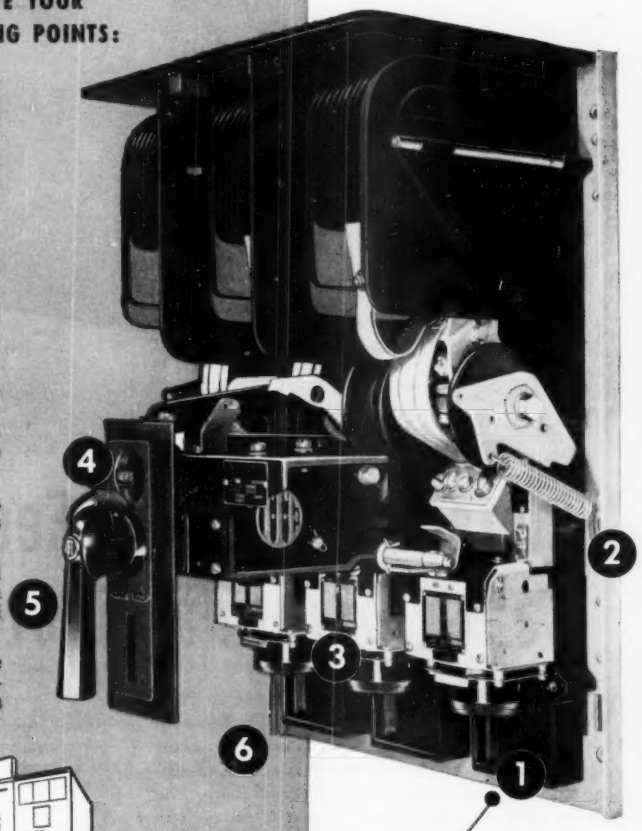
I-T-E "K" LINE CIRCUIT BREAKERS GIVE YOUR SWITCHGEAR THESE PROTECTIVE STRONG POINTS:

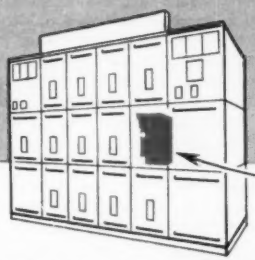
1. Each pole unit is supported in an individual insulating molding. Insulation between adjacent poles is greater than with older, insulated-panel-type breakers.
2. Strong, metal panel provides effective barrier between breaker and bus compartments. Lighter weight allows easier, more convenient breaker handling.
3. Direct acting Inverse-Time-Element overcurrent trip devices are available for every application:

   Dual thermal-magnetic type—for motor starting, running, and short-circuit protection.

   Dual magnetic type—for feeder and short-circuit protection.

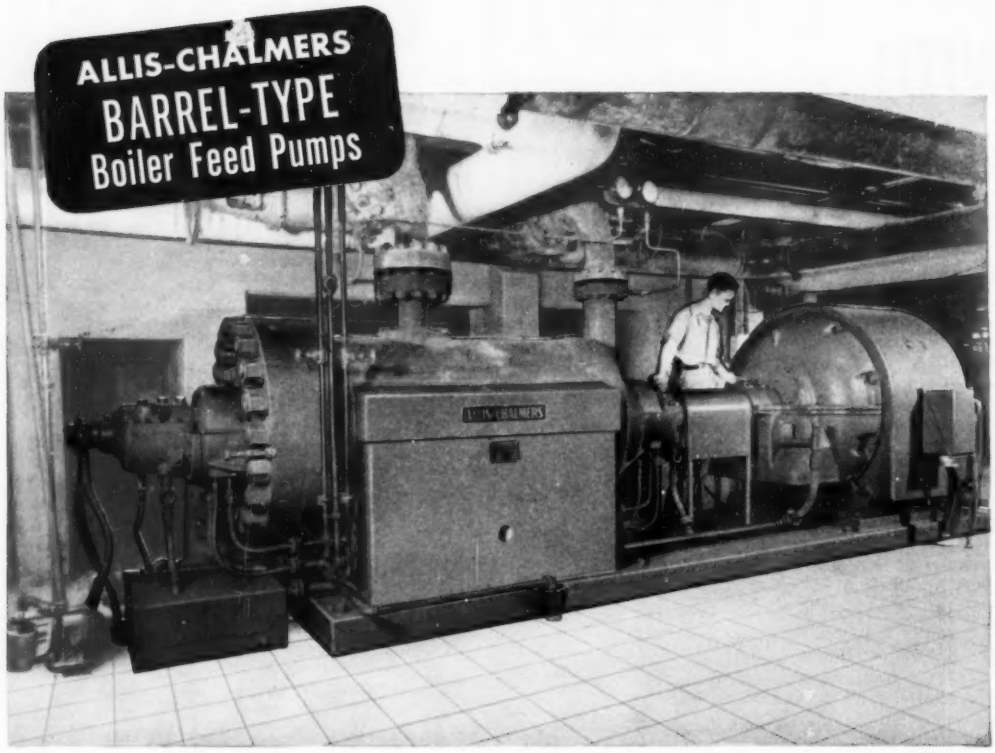
   Dual selective type—where coordinated tripping with other protective devices is essential.
4. Position indicator actually protrudes beyond surface of switchgear panel. It is easily visible from any angle.
5. Operating handles are directly connected to breaker mechanism. They are uniform in size, location and appearance in all manually operated breakers.
6. Constructed from unit assemblies, the breakers are easily inspected and maintained. Inventories of small renewal parts are kept to a minimum.





SWITCHGEAR

R&IE Equipment Division: Greensburg, Pa. • Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York 17, N.Y.



Install New Boiler Feed Pumps at South Carolina Electric and Gas

WHEN 50,000 KW CAPACITY WAS ADDED to Plant Hagood, South Carolina Electric and Gas Company, Charleston, South Carolina, this well know utility chose Allis-Chalmers barrel-type boiler feed pumps. The installations consists of two units like the one shown above. The pump is a 6x6, 11 stage rated at 485,000 lbs/hr or 1055 gpm at a total head of 4100 feet or 1630 psig. Water temperature is 300° F. The motor is an Allis-Chalmers two pole machine rated 1250 hp at 3575 rpm.

Allis-Chalmers barrel-type boiler feed pumps are proving their reliability and low cost of operation in a number of similar installations. Performance records have been such that more than 60 have been ordered for plants now being built.

Engineering Features

Proved engineering features mean you can depend on good performance and low maintenance. Single-stage back-to-back impellers balance axial forces without the use of a balancing drum. First stage has twin, half-capacity impellers to give the advantages of low NPSH. Expansion joint is on the outside of the pump. No flexible internal members are required to compensate for expansion.

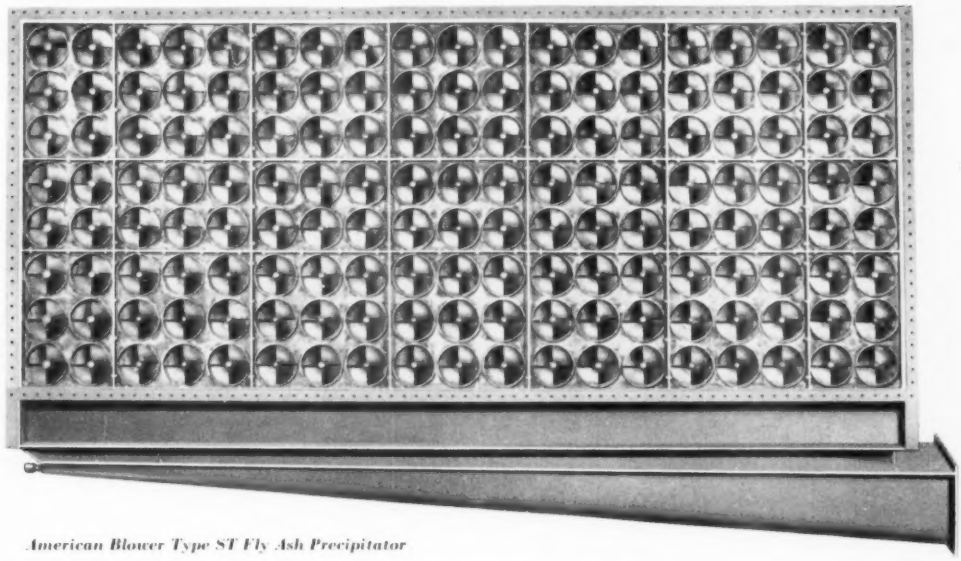
Sizes range from 1200 to 3000 psig and from 300 to 2500 gpm. Allis-Chalmers can supply the complete boiler feed pump package including pump, motor, and control of coordinated design and manufacture.

Get the details of this modern-design, performance-proved boiler feed pump from your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3672

ALLIS-CHALMERS

American Blower . . . a time-honored name in air handling



American Blower Type ST Fly Ash Precipitator

Memo to Power Plant Men—

In collecting fly ash from pulverized fuel-fired or stoker-fired boilers you'll have a higher efficiency curve over a wider range of operation if you install American Blower Type ST Fly Ash Precipitators.

AMERICAN BLOWER

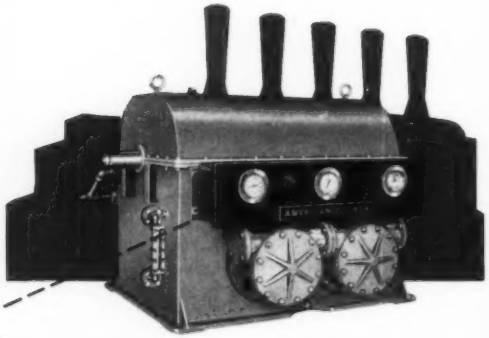
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

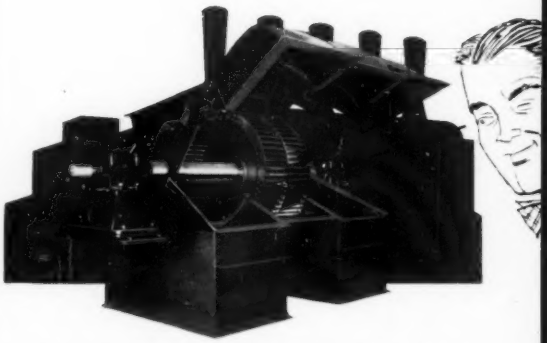
Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

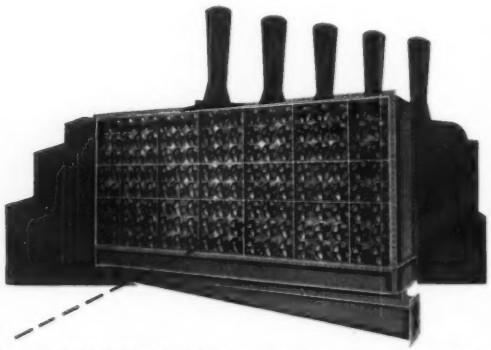
It all depends on how you look at it



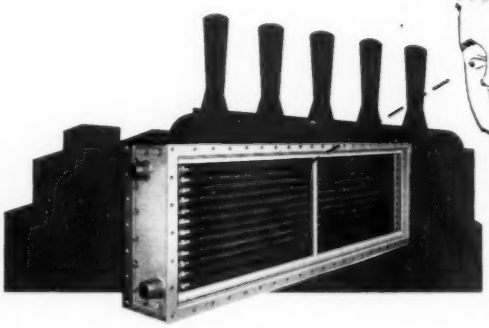
TO A CONTROL MAN this American Blower Class 6 Gyrol Fluid Drive, for flexible control of boiler feed pumps, looms up as big as this in relation to a power plant. He sees, too, American Blower Class 4 Fluid Drive for fan control.



TO A MECHANICAL DRAFT MAN a Sirocco Multi-Blade Fan, which delivers more gas per revolution than any other type, takes *this* proportion in the picture. He could see an American Blower HS Fan equally large if thinking of forced draft.



TO A FLY ASH EXPERT an American Blower Type ST Fly Ash Precipitator looks like this in relation to the rest of the power plant. Little wonder, for the Precipitator lifts a load off his shoulders and minimizes a nuisance.



TO A COIL MAN American Blower Heavy Duty Steam Coils would appear like this in his power plant picture. He likes their great strength, easy accessibility and the way they withstand the high pressures of heavy loads.

Looking at your complete power plant picture, we believe you'll find, as hundreds of others have, that all these American Blower Products improve over-all power-plant efficiency and insure years of dependable operation. Call our nearest Branch Office for complete data.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

Serving home and industry

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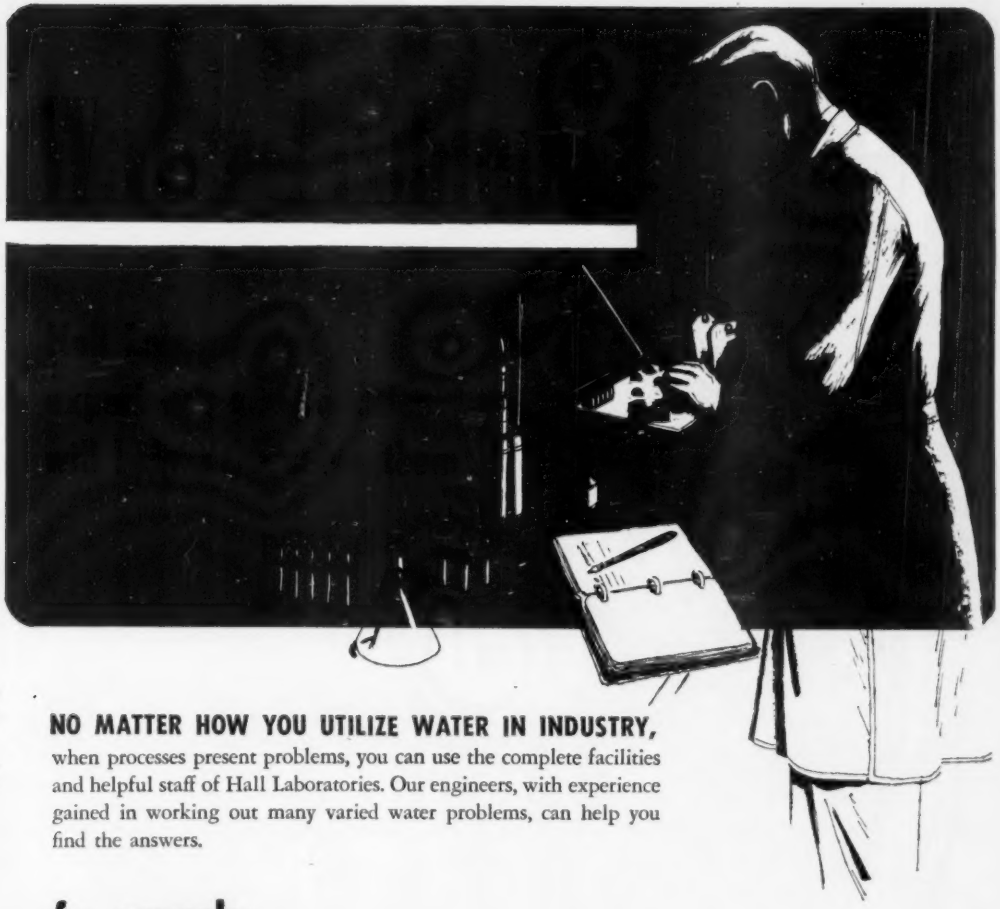


NO MATTER HOW YOU UTILIZE WATER IN INDUSTRY, when processes present problems, you can use the complete facilities and helpful staff of Hall Laboratories. Our engineers, with experience gained in working out many varied water problems, can help you find the answers.

for example:

SCALING and CARRYOVER in marine evaporators are troublesome. Hall has made an investigation with Bull & Roberts, Inc.* to determine how best to handle these problems in shipboard units producing distillate from fresh water and from sea water.

The combined experience of Hall engineering and research helped produce effective methods of treatment for these evaporators. One result: Five pounds of chemicals per 1,000,000 pounds of sea water fed to an evaporator worked wonders. This mixture, applied carefully and within specific operating limits, stopped scaling and reduced foam height over 90%.

For water problems of all kinds, check with Hall Laboratories. Write, call or wire Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.

* *Water conditioning specialists in the marine field.*

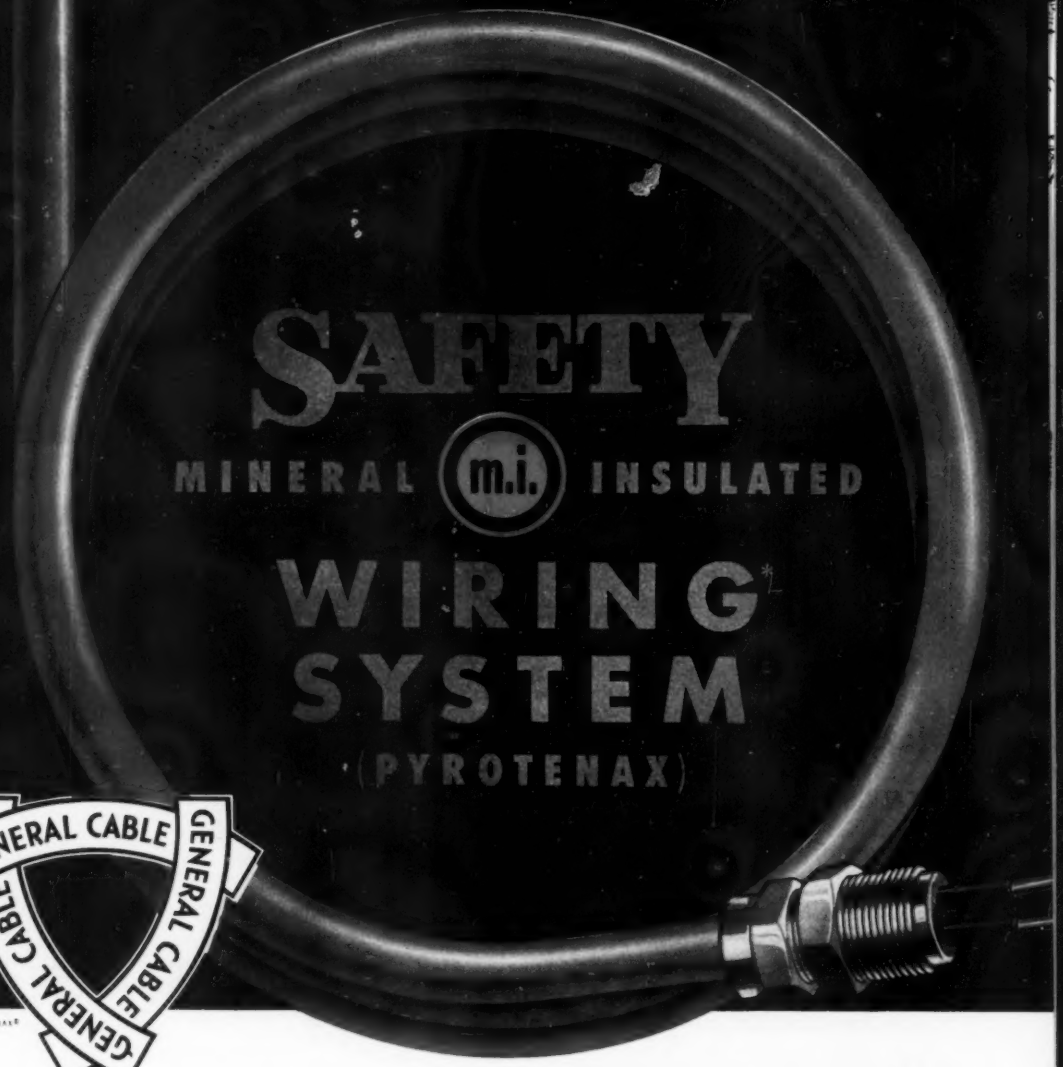
HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

HALL PLANT WIDE WATER SERVICE

Consultants on Procurement, Treatment, Usage and Disposal of Industrial Water

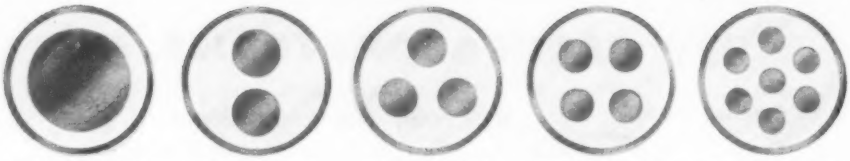
...and now



GENERAL CABLE

PYROTENAX®

SAFETY m.i. WIRING is available with fittings to connect to standard boxes and equipment.



SIZES 16 TO 4/0 A.W.G. | SIZES 16 TO 4 A.W.G. | SIZES 16 TO 4 A.W.G. | SIZES 16 TO 6 A.W.G. | SIZES 16 TO 10 A.W.G.

permanent
ELECTRICAL WIRING

...Wiring that will actually outlast the buildings in which it is installed.

Whatever the service, wherever the installation, if the job deserves the ultimate in quality of the wiring material, nothing less than a Safety m.i. Wiring System will suffice.

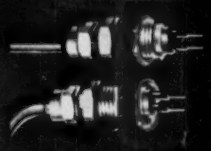
Uni-drawn, self-protected Wiring System, with dry mineral insulation offers the utmost in permanence, service-reliability and safety in all applications up to 600 volts.

As shown, this new General Cable wiring installs easily, with standard boxes, switches, etc. Its advantages are so unusual, so important that you will want to read this summary... and should.

**Exclusively a General Cable product*

OUTLASTS STRUCTURE IN WHICH INSTALLED!
Immune to age-deterioration due to its "all-mineral" construction. Unaffected by high temperatures resulting from current overloads, either accidently imposed or to meet emergency increased power demands.

ONE-STEP INSTALLATION!
No additional mechanical protection required. Safety m.i. Wiring is its own conduit, installed in one operation with standard switch and junction boxes. Smaller diameter saves space, gives neat appearance.



NO VAPOR PASSAGE!
Completely filled with compacted mineral insulation. No need for specially installed seals in the cable run normally required to prevent the passage of combustible gases through a wiring system.

Note the smooth transition bends in this bank of power plant circuits.

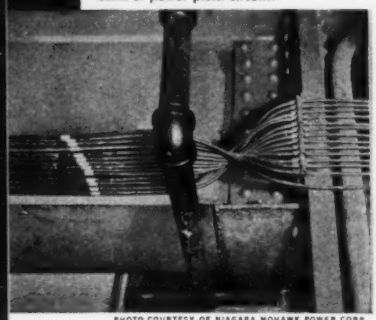


PHOTO COURTESY OF NIAGARA MOHAWK POWER CORP.

Typical close-up of machine wiring, smooth, easily kept clean — and of small diameter.

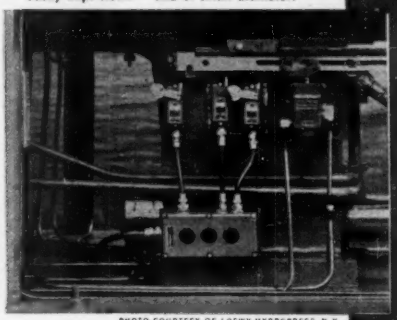
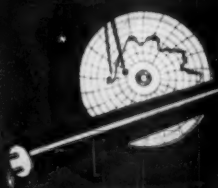


PHOTO COURTESY OF LOEWY-HYDROPRESS, N.Y.

COMPLETELY MOISTURE-PROOF!
Simple fittings permanently seal both ends of each run of wiring. No possible entrance for moisture. Normal concern over this hazard is, thereby, completely eliminated.

RIGID YET FLEXIBLE!
Thumb-pressure bending, in ordinary sizes, easily fashions orderly wall patterns — conforms wiring to any contour. Once formed, and fastened with standard clamps or straps, Safety m.i. Wiring stays put rigidly.

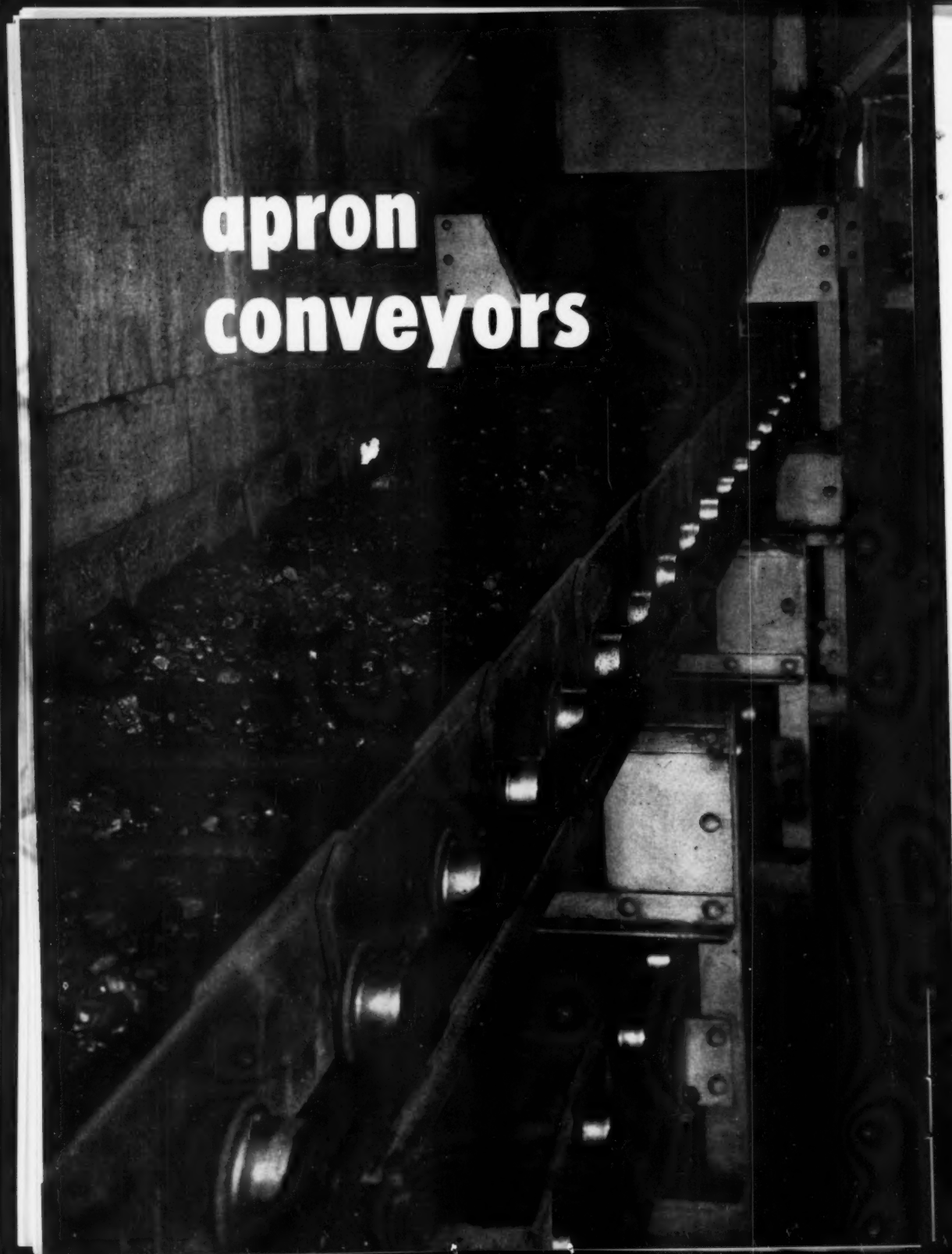
NO HEAT DETERIORATION!
The mineral insulation of Safety m.i. Wiring is physically stable up to 2800° C., thereby assuring against deterioration by heat, even beyond the melting point (1083° C.) of the copper sheath.



GENERAL CABLE
CORPORATION

EXECUTIVE OFFICES: 420 LEXINGTON AVE., NEW YORK 17, N. Y.
SALES OFFICES IN PRINCIPAL CITIES OF THE UNITED STATES

"More Power to You" ®


apron
conveyors

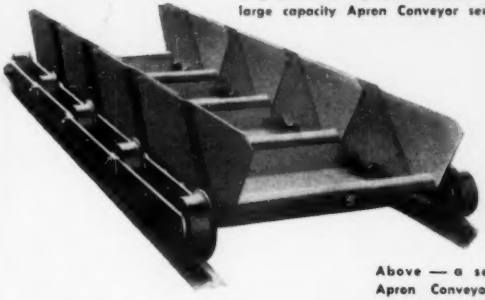
A section of Steel Thimble Roller Chain with long pitch, having extended side bars for large capacity Apron Conveyor service.

RUGGED CONVEYORS

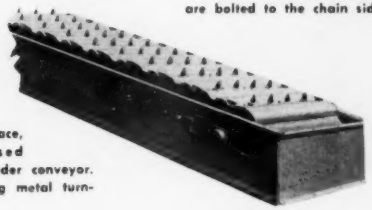
Serving Many Diversified Industries

Coal . . . Coke . . . Crushed Stone . . . Burnt Lime . . . Hot Sand from Shake-out . . . Castings

Inclined or Horizontal . . . Can Be Made LEAK-PROOF

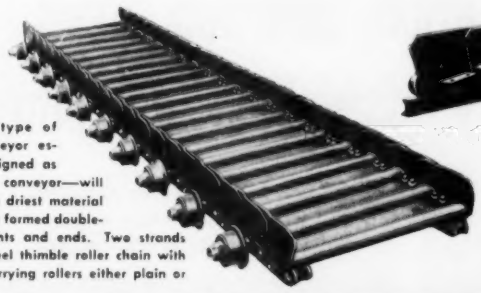


Above — a section of Apron Conveyor — de-pressed pan type. Mount-ed on Steel Thimble Roller Chain with flanged rollers for operating on rails as shown. The pressed steel bottoms are welded to the overlapping ends which are bolted to the chain side bars.



With tooth surface, this unit is used widely as a feeder conveyor. Ideal for feeding metal turn-ings to crusher.

Jeffrey Apron Conveyors and Apron Feeders will provide all-day, contin-uous service. Send for additional in-formation.

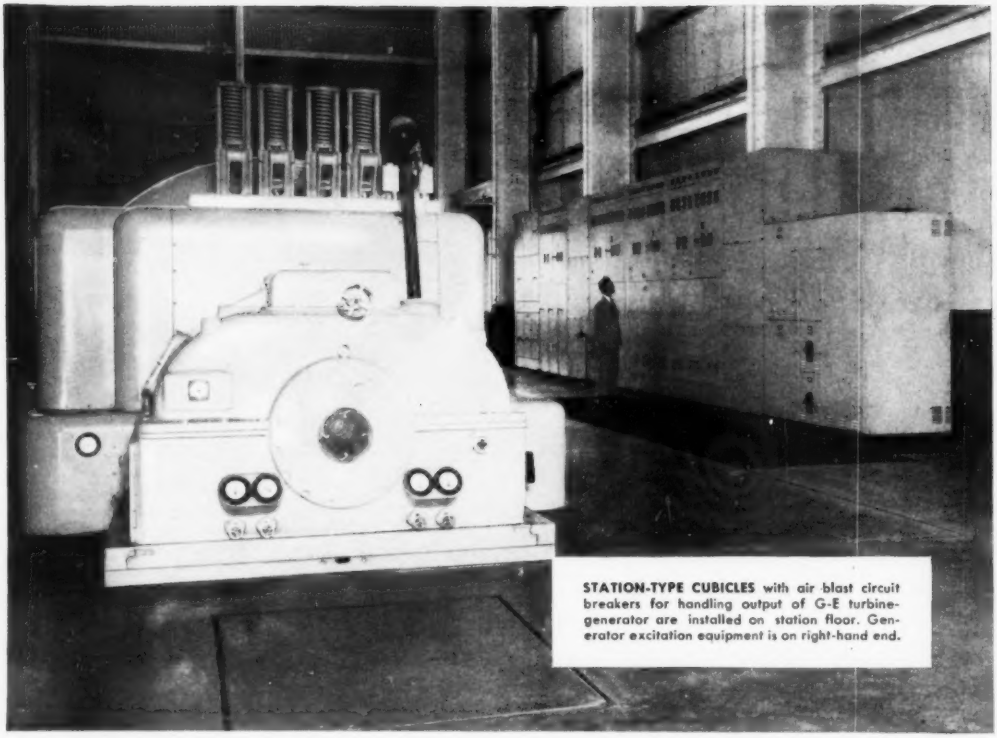


A rugged type of Apron Conveyor es-pecially designed as a shake-out conveyor—will not leak the driest material —accurately formed double-beaded flights and ends. Two strands of heavy steel thimble roller chain with outboard carrying rollers either plain or antifriction.

This section of Apron Conveyor has its ends formed by the extension of the chain side bars. The beaded and curved, or perfect discharge flights offer no resistance to flow of material.

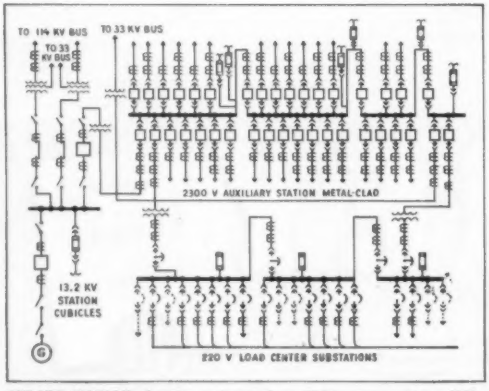
THE JEFFREY MANUFACTURING COMPANY

1877 75 1952



STATION-TYPE CUBICLES with air-blast circuit breakers for handling output of G-E turbine-generator are installed on station floor. Generator excitation equipment is on right-hand end.

60,000-kw station addition uses completely factory-assembled equipment


TO 114 KV BUS
TO 33 KV BUS
TO 33 KV BUS
2300 V AUXILIARY STATION METAL-CLAD
13.2 KV STATION CUBICLES
220 V LOAD CENTER SUBSTATIONS

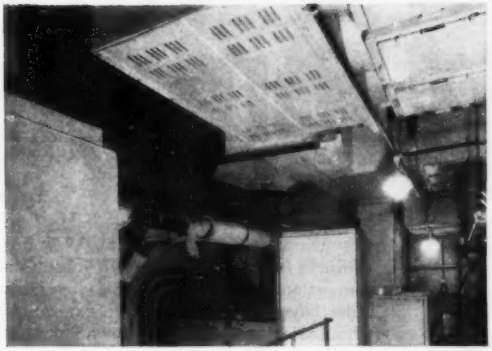
ONE LINE DIAGRAM of station equipment shows 13.2-kv station cubicles, 2300-v metal-clad switchgear and 220-v station auxiliary load-center unit substations.

Planned as a Project from Generator to Power Transformer with G-E METAL-ENCLOSED COMPONENTS

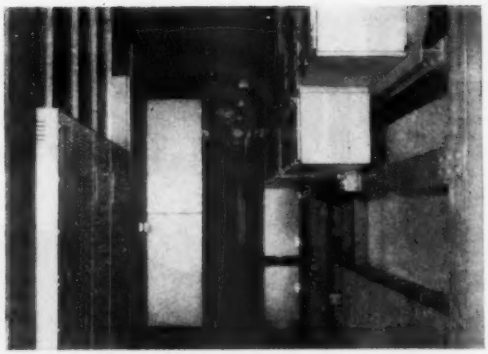
An outstanding example of compact, unified design, this 60,000-kw addition to New Jersey Power & Light Company's Gilbert Station illustrates the many advantages of complete station project planning with G-E standardized equipments.

All major units of the plant electrical equipment were supplied as a factory-assembled "package," ready to install. Station engineering was greatly simplified. "On the job" assembly was reduced to a minimum. And complete metal enclosure of all components assures maximum safety and dependability.

For complete information on G-E station-type equipments, see your local G-E sales representative or write to *General Electric Company, Schenectady 5, N. Y.*

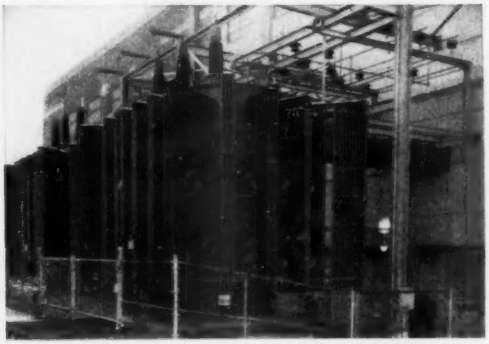


METAL-ENCLOSED ISOLATED-PHASE BUS conducts power from generator to switchgear cubicles and from cubicles to power transformer bank. Close coupling between generator and cubicles saves copper. Factory assembled units were easy to install.

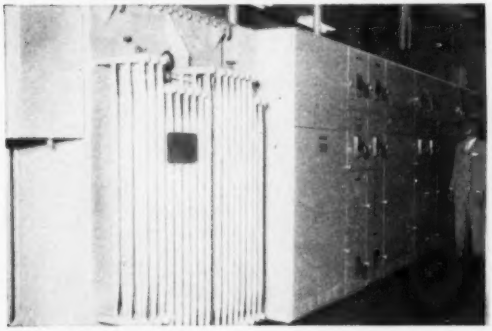


BACK VIEW—STATION CUBICLE SWITCHGEAR AND EXCITER BOARD, showing isolated-phase bus to outdoor power transformers. Metal-enclosed construction gives complete protection. Hinged covers removable for inspection.

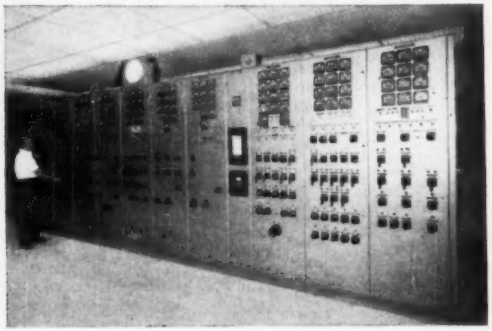
METAL-CLAD SWITCHGEAR with magne-blast power circuit breaker for station service. Shipped ready to install, complete with circuit breakers, interconnections, busses and interlocks—all in one package.



ISOLATED-PHASE BUS TO POWER TRANSFORMERS with throat-connected seal-off bushings are used at building wall to provide a weather-tight seal. Factory assembled units ensure ease of installation and provide maximum protection.



LOAD-CENTER UNIT for low voltage service. Entire assembly ordered and shipped as a factory-co-ordinated unit, ready to install. Air circuit breakers are draw-out type for easy testing and inspection.



METAL-ENCLOSED DUPLEX CONTROL BOARD provides centralized control and metering. Control and indicating equipment is mounted on front panels and recording, regulating and protective equipment on rear.

GENERAL ELECTRIC

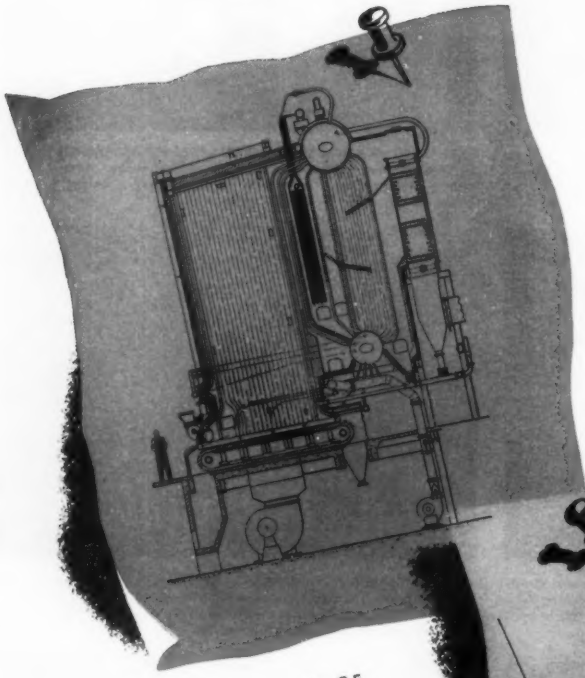
855-30

They keep coming

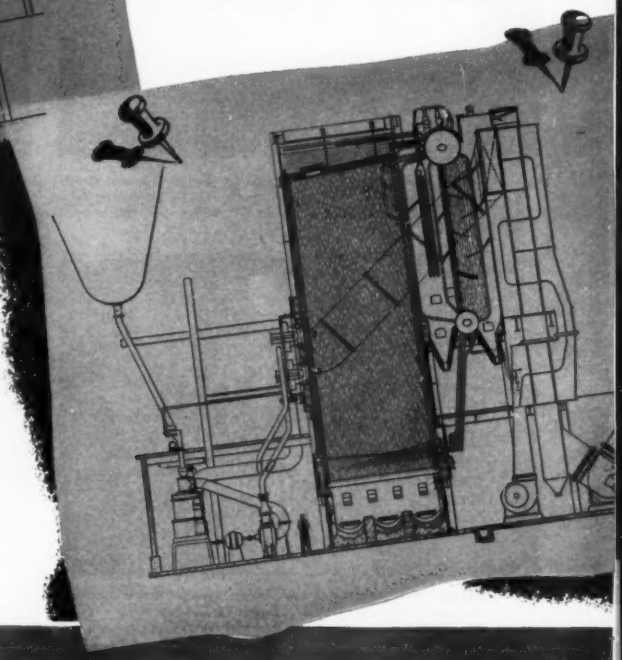
Companies that have bought VU Boilers *continue to buy them.* In fact, a substantial proportion of all VU Units, in service and on order, have been purchased by organizations whose selection reflects their own first-hand experience. *For example —*

A STEEL COMPANY now has a total of eleven VU Boilers in four different plants. Starting with three units in 1936, it has reordered three times... most recently in the fall of last year with an order for three more units.

A TEXTILE MANUFACTURER ordered two VU Units in 1936. Another unit was installed in 1940 and a third in 1944. Still another



VU-50 Unit fired with C-E Spreader Stoker (continuous discharge type). The capacity of unit shown is 80,000 lb steam per hr; operating pressure 425 psi steam temperature 650 F.



VU-50 Unit fired with pulverized coal. The capacity of unit shown is 200,000 lb of steam per hr; operating pressure 560 psi; steam temperature 760 F (VU units are in service for capacities up to 350,000 lb of steam per hr).

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

back for more!

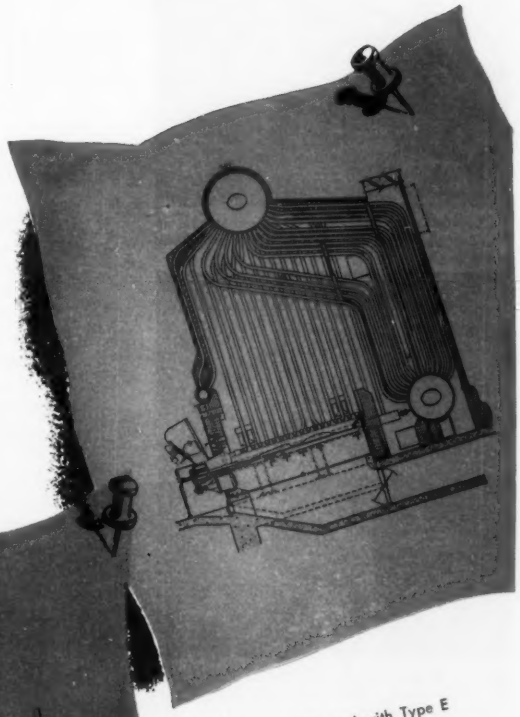
textile company installed one unit in 1945, a second in 1949 and has just ordered another.

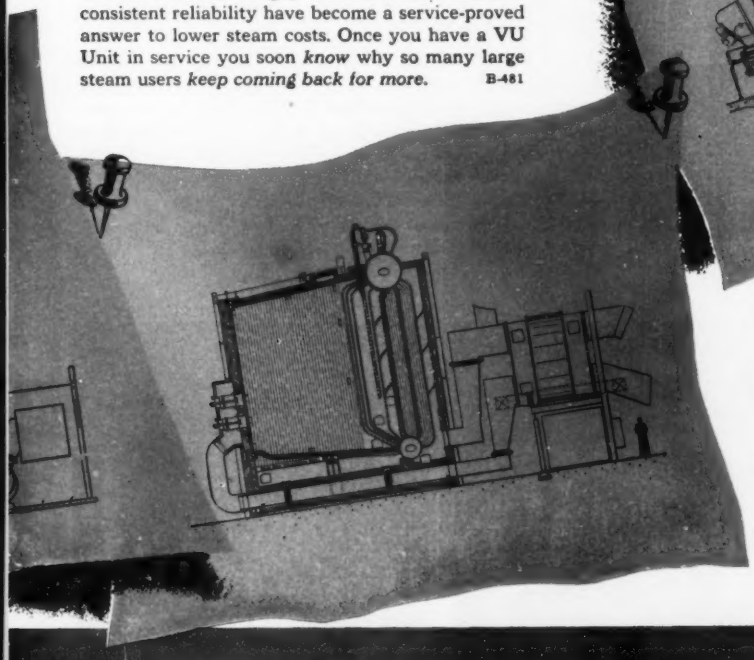
A REFINING COMPANY ordered one VU Unit in 1937, another in 1940 and another in 1949 for one of its plants; also two in 1942 and one in 1947 for another plant.

A SEWAGE TREATMENT PLANT in one of America's large cities is another consistent buyer of VU Boilers. Its initial order in 1936 was for two units. Since then it has reordered three times, and now has a total of seven VU Boilers in service.

• • •

The story is the same wherever you go — in all sections of the country American industry is ordering and *reordering* VU Units. Why? Because the VU's advanced design, sound construction and consistent reliability have become a service-proved answer to lower steam costs. Once you have a VU Unit in service you soon *know* why so many large steam users *keep coming back for more.* B-481





VU-10 Unit fired with Type E Stoker. VU-10 Boilers range in capacity from 10,000 to 60,000 lb steam per hr. They may be fired by spreader, underfeed or chain grate stokers, or by oil or gas.

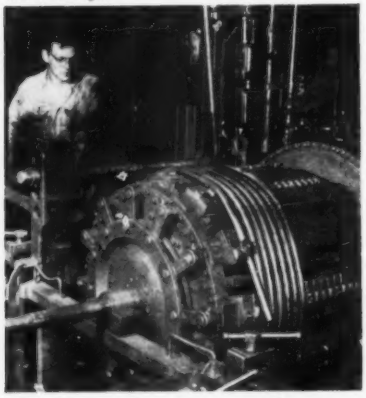
VU-50 Unit fired with oil or gas. The capacity of unit shown is 175,000 lb of steam per hr; operating pressure 400 psi; no superheat.

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

THIS WORKMAN is welding standard lengths of National Seamless Tubing into a continuous 200 or 300 foot length.



HERE, the National Seamless is cold wound into shape. It easily withstands this severe forming operation.

using 561 feet of NATIONAL

Midget generator

● This four-car railroad pile driving rig has a total weight of over *660,000* pounds.

On just 75 gallons of oil per day, the steam generator shown here* (similar to the type used to heat diesel powered passenger trains) will move the entire rig down the track at 15 to 20 miles per hour, drive the air brake compressor, operate the hammer continually and furnish steam for the hoist—all this in a generator you could put in an ordinary clothes closet!

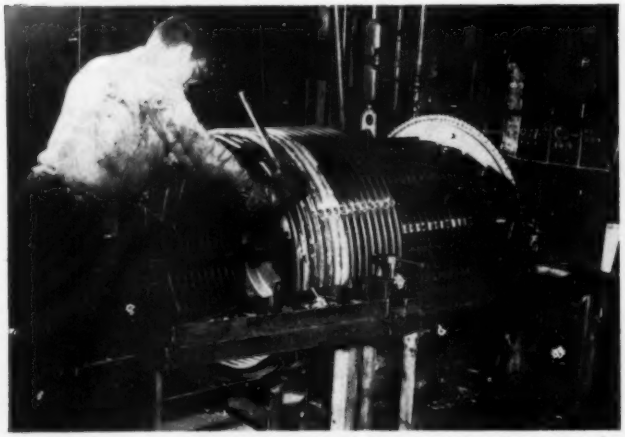
For size and weight, this is the most powerful steam-making machine ever developed.

Heart of this generator is a set of National Seamless Steel Tube coils over 561 feet long. Standard lengths are welded into 200 or 300 foot lengths, then cold rolled into a coil that must withstand a 1200 psi hydrostatic pressure test.

The National Seamless Tubes do a fine job despite the severe fabrication method and rigorous tests. These tubes can take it, because there aren't any welds to weaken or injure the tube. Every tube is actually pierced from a solid billet of high quality steel—the *one* manufacturing method that removes all doubt concerning uniform wall strength.

When you plan to use tubes in the future, be sure to specify National Seamless. They are made by the world's largest, most experienced manufacturer of tubular steel products.

**Manufacturer's name on request.*



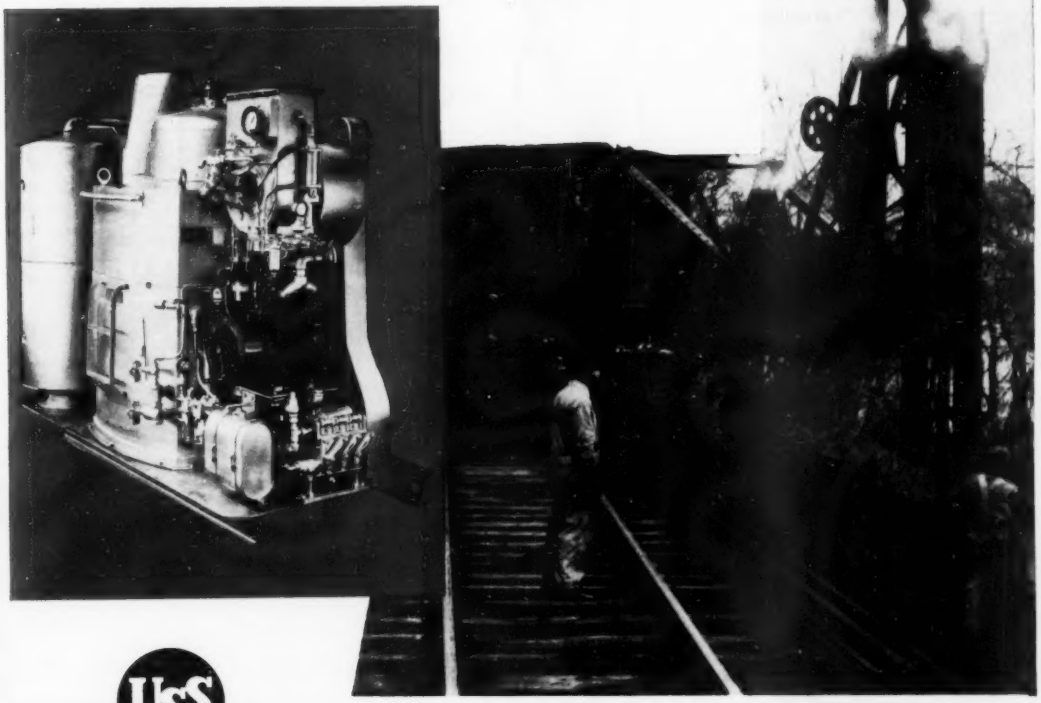
AFTER THE COILS are welded into position, the jig collapses and the coils are removed.

COMPLETED COIL is now lowered into position, ready to carry cold (50°F.) water into the 3000°F. flame.

SEAMLESS TUBES

drives giant pile driver

develops full pressure in just 2 minutes from a cold start



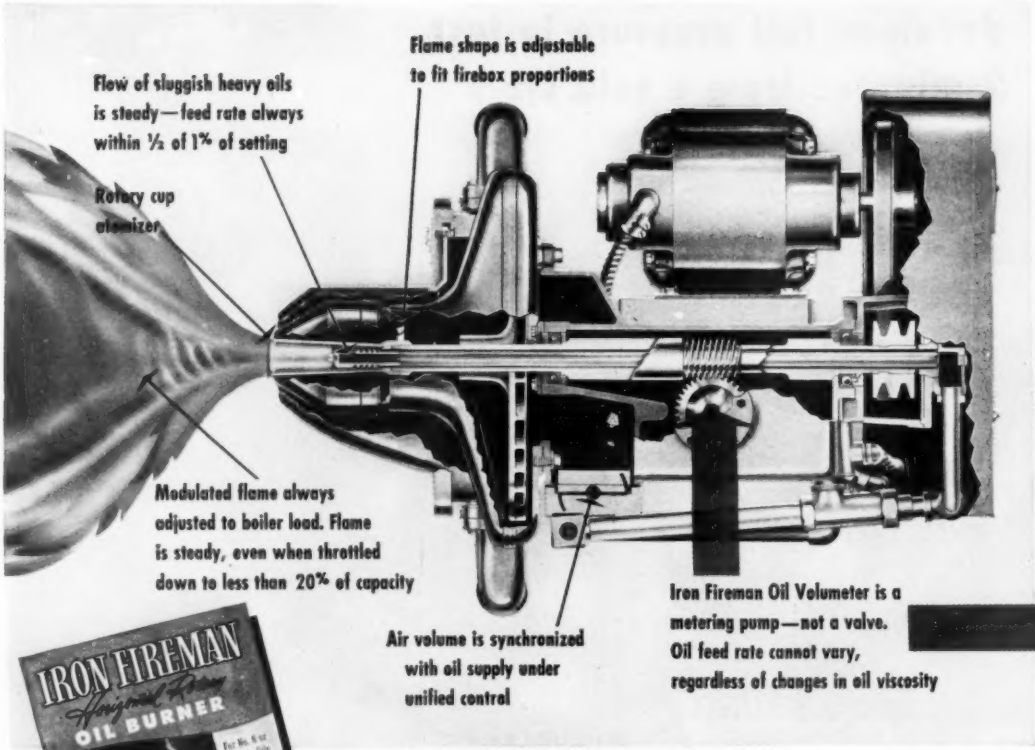
USS

NATIONAL TUBE DIVISION, UNITED STATES STEEL COMPANY, PITTSBURGH, PA.
(TUBING SPECIALTIES)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S NATIONAL *Seamless* TUBES

UNITED STATES STEEL

How Iron Fireman heavy oils


Flame shape is adjustable to fit firebox proportions
Flow of sluggish heavy oils is steady—feed rate always within ½ of 1% of setting
Rotary cup atomizer
Modulated flame always adjusted to boiler load. Flame is steady, even when throttled down to less than 20% of capacity
Air volume is synchronized with oil supply under unified control
Iron Fireman Oil Volumeter is a metering pump—not a valve. Oil feed rate cannot vary, regardless of changes in oil viscosity

Send for this 16-page book

This 16 page book (yours for the asking) explains in detail the operation of the Iron Fireman Horizontal Rotary oil burner, with large cut-away illustrations showing engineering and mechanical features. Also shows Iron Fireman gas-oil-coal firing, with fuels interchangeable at short notice.

IRON FIREMAN MANUFACTURING CO.
3247 West 106th Street, Cleveland 11, Ohio

Please send booklet, "Iron Fireman Horizontal Rotary Oil Burner."

Name_____

Address_____

OIL, GAS, COAL FIRING

IRON

THE IRON FIREMAN

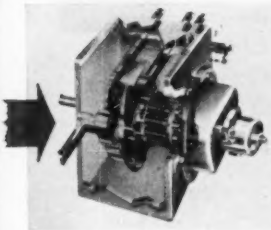
fires low-cost *efficiently*

Iron Fireman Horizontal Rotary Oil Burner handles the heaviest industrial fuel oils with accuracy and precision

The troublesome, temperature-sensitive heavy oils (Nos. 5 and 6) are completely reliable fuels when fired with this Iron Fireman industrial oil burner. Its characteristics include dependable cold starting; a steady, even flame through an exceptionally wide firing range; and high combustion efficiency that stretches fuel dollars.

No viscosity adjustment is required. Outstanding proof is the fact that Iron Fireman burners have long been operating in an asphalt plant, fueled by the by-products of the refining processes. These refuse oils vary from the heaviest oils to liquids as light as kerosene. Iron Fireman takes them as they come, without adjustment or other attention.

Synchronized fuel and air control, operated either manually or automatically, keeps air-fuel ratio correctly adjusted, regardless of firing rate.



Iron Fireman Oil Volumeter is secret of oil control

Oil is metered to the burner head under *low pressure* by a variable volume pump. Submerged in the oil reservoir, a multi-piston cylinder block revolves, pulling oil into each cylinder in turn, and a half revolution later ejecting it into the feed line. The fuel-feed rate is determined by the length of the piston stroke, and is *not affected by any other factor.* No valves, no viscosity compensating devices—just a steady, accurately metered oil supply.

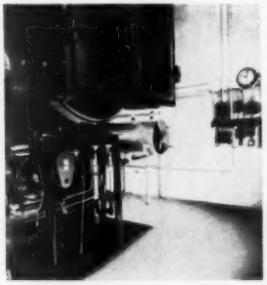
FOR HEATING, PROCESSING, POWER

FIREMAN

Mr. J. Mayberry, Vice President
Quality Mills Mount Airy, N. C.
Manufacturers of
Quality Knit underwear

"We save $3800 a year with our Iron Fireman Rotary Oil Burner"

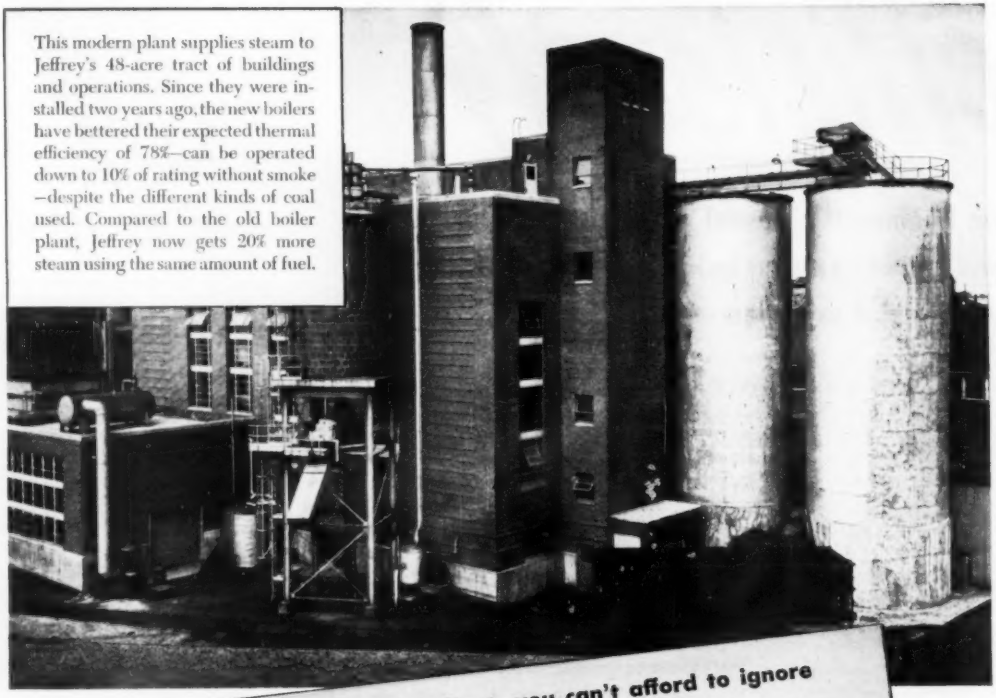
"We have just checked the operating cost figures on our Iron Fireman Rotary oil burner," writes Mr. Mayberry, "and have found that we have a saving of $1,800 in fuel cost over our previous firing method. In addition to this we are saving the cost of a fireman on our first shift which amounts to approximately $2,000 per year. The efficiency of this unit has enabled us to save a great deal of time on many of our operations calling for quick steam. Needless to say, we are very well pleased with this installation. If you would like to have anyone inspect our boiler room at any time, please feel free to do so."



The Quality Mills steam plant is fired by an Iron Fireman Model RAH burner, completely automatic, with gas-electric ignition. Fuel used is No. 6 oil. Rated capacity of burner is 75 gallons per hour, capable of carrying a boiler load of approximately 250 boiler horsepower.

"$52,000 A YEAR-

This modern plant supplies steam to Jeffrey's 48-acre tract of buildings and operations. Since they were installed two years ago, the new boilers have bettered their expected thermal efficiency of 78%—can be operated down to 10% of rating without smoke—despite the different kinds of coal used. Compared to the old boiler plant, Jeffrey now gets 20% more steam using the same amount of fuel.



If you operate a steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-priced fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

THAT'S WHAT JEFFREY SAVES BY BURNING COAL THE MODERN WAY!

AUTOMATIC, DUSTLESS COAL HANDLING SAVES US $9,980 IN LABOR ALONE,"

says H. W. deBruin, Vice President in Charge of Manufacture, The Jeffrey Manufacturing Company, Columbus, Ohio

This enclosed screw conveyor delivers coal to the main bunker over the firing aisle. *The entire coal handling system can now be controlled by one man.* Compared to the old method, Jeffrey saves $6,080 annually in car-unloading costs alone. And ash removal is completely automatic and dustless, too—saves an additional $3,900.

The plant's firing aisle—showing the two-ton traveling weigh larry that delivers coal to the boilers. Steam generating costs, not including depreciation, are—**old plant, $.598 per thousand pounds . . . new plant, $.455 per thousand pounds. Total savings, including savings in coal handling, amount to exactly $52,904 annually!**

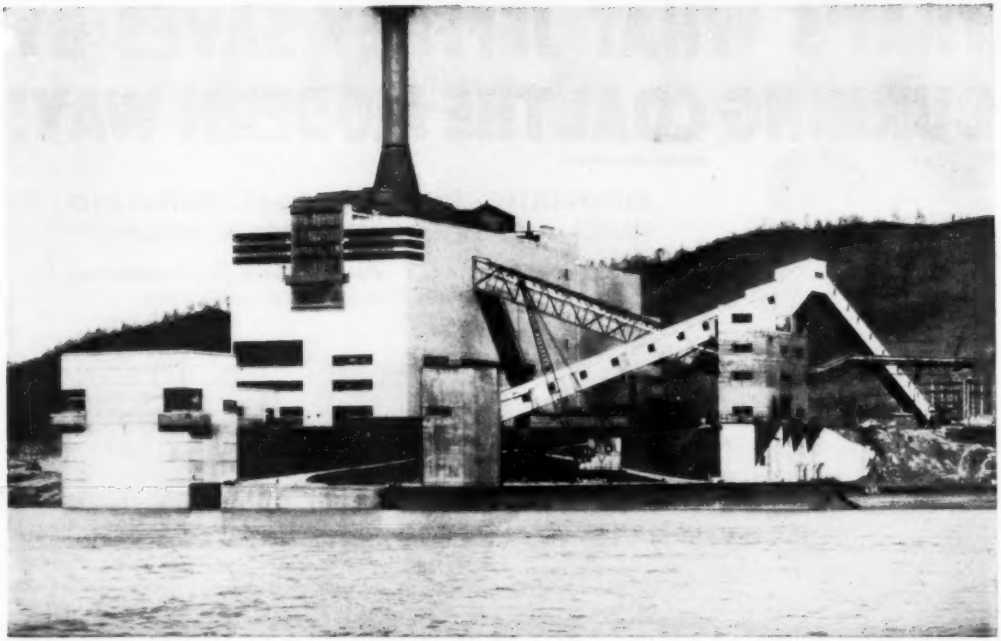
Handle coal efficiently, fire it properly, and you can save *big* money! Today, modern combustion and coal-handling equipment add greatly to *bituminous* coal's inherent economy. You can now get anywhere from 10% to 40% more power from each ton of coal than was possible a few years ago.

If you are planning to modernize your present installation, or if you're building a new steam-generating plant, call in a competent consulting engineer. He'll give you the facts—show you how it will pay you and pay you well to burn coal in a modern installation designed to meet your specific needs.

And with coal you get the added advantage of a future dependability no other fuel can offer. Of all America's fuel reserves, 92% is coal. And to supply this coal, America has the world's most productive coal industry. For economy, for dependability, both now and for the future, you can count on coal!

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

Z1.1

WORTHINGTON

WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters · Boiler Feed Pumps · Steam Turbines
Steam-Jet Ejectors · Water Treating Equipment · Surface Condensers

LADISH

Controlled Quality

PIPE FITTINGS

reduce piping assembly time

Makeup goes smoother... with less chance for delay... on those piping systems where Ladish fittings are installed. Ladish Controlled Quality makes the difference. By exacting controls over materials and manufacturing processes... Controlled Quality assures uniform weldability through metallurgical integrity, fast assembly through dimensional accuracy and provides a real assurance of ultimate operating economy and complete dependability... reasons why it pays to specify LADISH.

TO MARK PROGRESS

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
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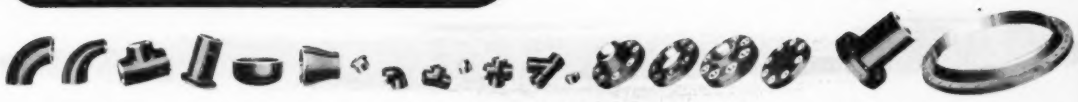


correct

FUEL-AIR RATIO
FUEL FEED OVER-FIRE DRAFT

GET ALL *Three* AND HAVE THESE RESULTS

1 More steam from your present boiler.

2 Less fuel — coal — oil — gas reauired.

3 Savings in maintenance whether you have a single boiler or battery of boilers.

WHETHER YOU HAVE ONE OR A BATTERY OF BOILERS . . . INSTALL

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

CASH STANDARD FUEL FEED CONTROLLER • • •

Automatically Regulates Fuel Feed

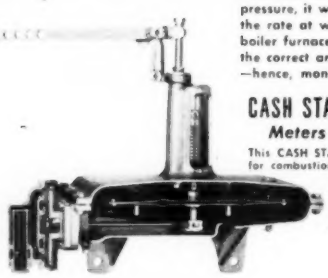
This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion —hence, money saving.

Bulletin No. 300

Shows Applications
Tells How the System Works in Your Favor

Tells about Correct fuel feed —Correct fuel-air ratio— Correct over-fire draft and how you get all three. It shows applications and how various CASH STANDARD Units can be made to meet any specific condition and work on any boiler or stoker with any kind of fuel.

Send for it



CASH STANDARD AIR FLOW CONTROLLER • • •

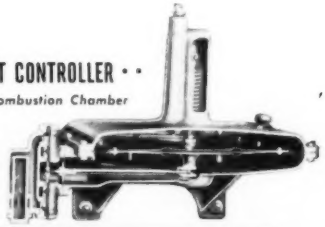
Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

CASH STANDARD FURNACE DRAFT CONTROLLER • •

Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

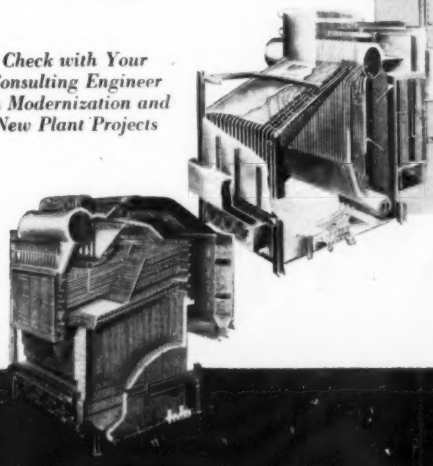
For America's FINEST!

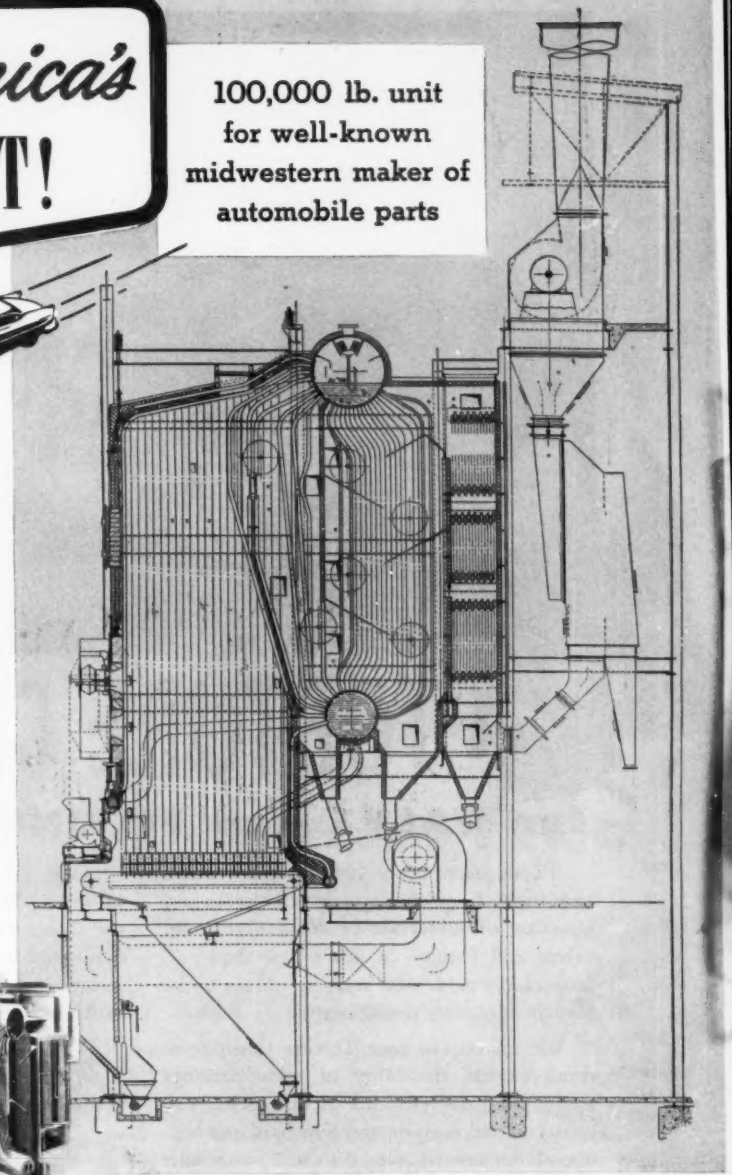
100,000 lb. unit for well-known midwestern maker of automobile parts

■ *Many* of America's finest industrial plants are now equipped with latest type Springfield Steam Generating Units, designed especially to meet today's needs. The unit shown at the right is the third of this design ordered by one of the country's largest makers of electrical parts for automobiles. Like numerous others, this company has placed its seal of approval on Springfield with REPEAT ORDERS!

Springfield Boiler Company specializes in the production of a complete range of steam generating equipment ... ANY SIZE ... ANY PRESSURE ... ANY TEMPERATURE ... AND FOR ANY FUEL. Springfield is organized to apply the same engineering skill to all contracts, large or small. We will be glad to submit a proposal covering your requirements.

Check with Your Consulting Engineer on Modernization and New Plant Projects





This 2-drum Springfield Steam Generator is designed for 225 psig and operates at 150 psig. The design features a completely water cooled furnace, economizer, forced and induced draft fans, and dust collector. Firing is by traveling grate spreader stoker.

TORTURE CHAMBER

for VALVE and FITTING MATERIALS

Here, steam up to 1500 pounds pressure and 1000° F. gives Vogt the answer to any question of materials or construction for valves and fittings in just a few days . . . facts that would take years to obtain under normal operating conditions!

We set up our own Torture Chamber to determine the durability of valve packings and gaskets; the resistance of various steels to corrosion and erosion; and how hard and how smooth surfaces of seats, discs and stems must be to withstand steam at high pressures and high temperatures. We tested and found an ideal yoke nut material, and we uncovered facts on joint design that could be found in no other way.

Thus, by constant and accelerated testing, we quickly and definitely prove or disprove the claims that are made for many newly developed materials. And thereby we make sure that only the best goes into valves and fittings that bear the name Vogt.

Consult Catalog F-9 for the complete Vogt line of drop forged steel valves, fittings and flanges for steam, water, oil, gas, air and refrigeration services.

HENRY VOGT MACHINE CO., Louisville 10, Ky.

BRANCH OFFICES: NEW YORK • CHICAGO • CLEVELAND
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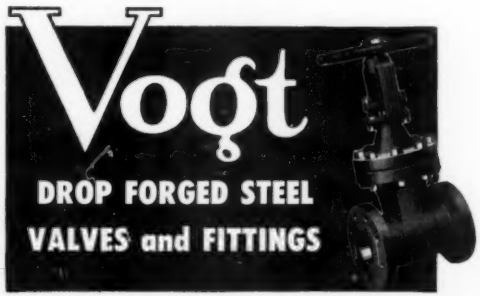
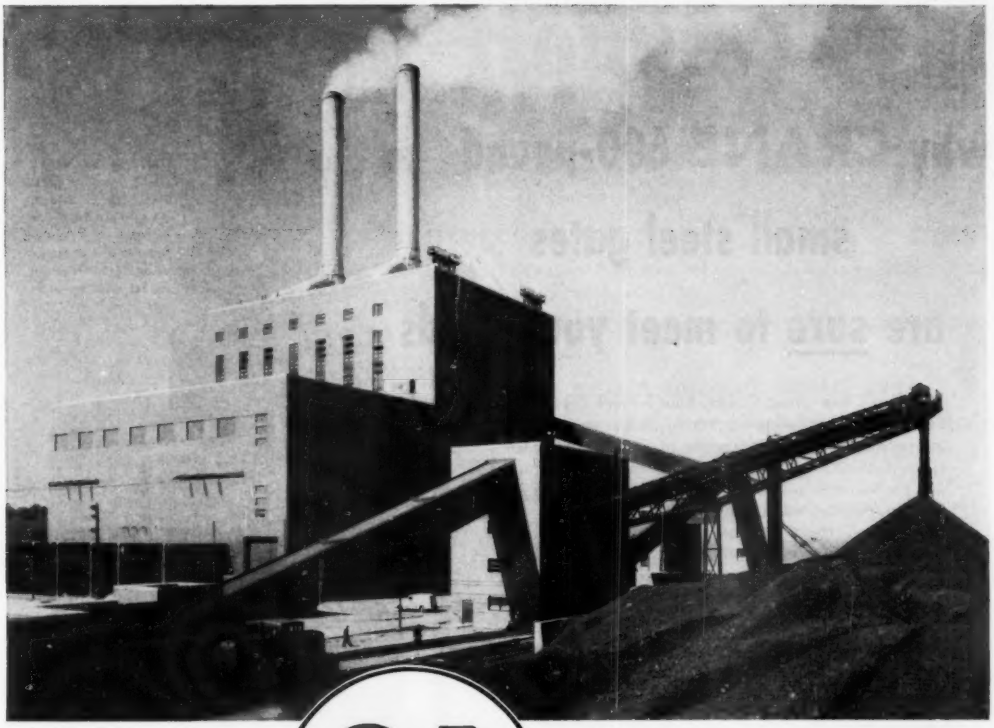




At the new steam station of the Niagara Mohawk Power Corp., a complete S-A coal handling system moves incoming coal from rail cars to a breaker house, then to bunkers in the boiler house or to outdoor storage. Reclaimed coal is delivered from storage to a ground level hopper where it re-enters the conveying system for delivery to boiler house bunkers. This well planned system combines maximum flexibility and economy.

S-A CONVEYING Systems

can simplify **ANY** Coal Handling Problem

It's no accident that power plant men have increasingly turned to S-A designed and equipped coal handling systems for economical solutions to their coal conveying problems. For over 50 years S-A engineers have come up with sound answers—whether for a simple conveyor or for complete distribution systems, with flexible "pick-up and delivery" at many points—all *at lowest handling cost per ton.*

Such installations are typical of the versatility of S-A engineering. S-A makes all types of bulk material handling equipment. Hence, we can be unbiased in recommending the most suitable units or combinations of units for any need, no matter how specialized. Write for details.

Belt Conveyors
Belt Trippers
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Weigh Larries
Crushers, Roll & Ring Type
Bucket Elevators
Gravity Discharge Conveyors
Pivoted Bucket Carriers
Flight & Chain Conveyors
"Natural Frequency" Vibrating Conveyors
Screw Conveyors
Skip Hoists
Belt, Pan & Plate Feeders
Pan Conveyors
Track Hoppers & Bin Gates
Conveyor Belt Cleaners
Headshaft Holdbacks
Speed Reducers & Bearings
Car Pullers & Spotters
TELLEVEL Bin Level Controls
Hoists & Winches
Centrifugal Pilers
Water Intake Screens
SealMaster Ball Bearing Units
Write for a bulletin on any of the above

STEPHEN S-A ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

why CRANE 600-pound small steel gates are sure to meet your needs

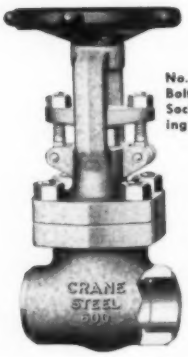
UNION BONNET GATE. Screwed ends. Sizes: ¼ to 2-inch. Available in three different trim materials for a wide range of services. Also with socket welding ends

You can't top these Crane Small Steel Gates for dependable performance on high pressure, high temperature lines . . . for ease of operation . . . for simplified maintenance. That's because they include design features normally found only in larger or more expensive valves.

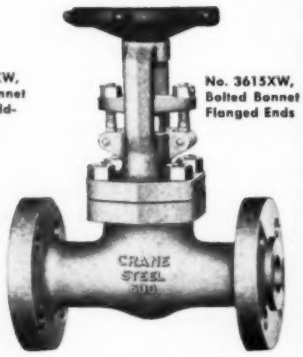
Then too, these Crane valves are available in a choice of types to meet your particular requirements. For example, with union or bolted bonnets; with screwed, flanged, or socket-welding ends; and in trim materials recommended for all common fluids.

GET NEW DESCRIPTIVE CIRCULAR AD-1881

For complete information—including prices—about these longer lasting, easier operating Crane Small Steel Gate Valves. Ask your Crane Representative for your copy, or write direct. No obligation.

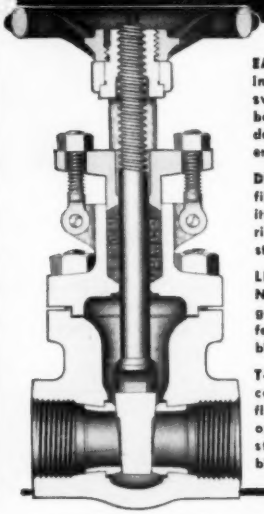


No. 3611XW, Bolted Bonnet Socket-Welding Ends



No. 3615XW, Bolted Bonnet Flanged Ends

Easy to Operate... Easy to Service



EASY ACCESS to stuffing box assured by swinging gland eyebolts. Improved yoke design provides liberal working space.

DEEP STUFFING BOX filled with high quality asbestos packing rings maintains tight stem seal.

LEAKPROOF BONNET JOINT. Soft iron gasket in male and female joint cannot blow out.

T-HEAD DISC-STEM connection provides flexibility for smooth operation; prevents stem distortion or binding of parts.

Cross-section No. 3607XW, Bolted Bonnet Gate, Screwed

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Unloading Hopper Cars

IS A FAST, ONE-MAN OPERATION

Unloading Time

Actual examples with Allis-Chalmers car shaker. Good unloading facilities.

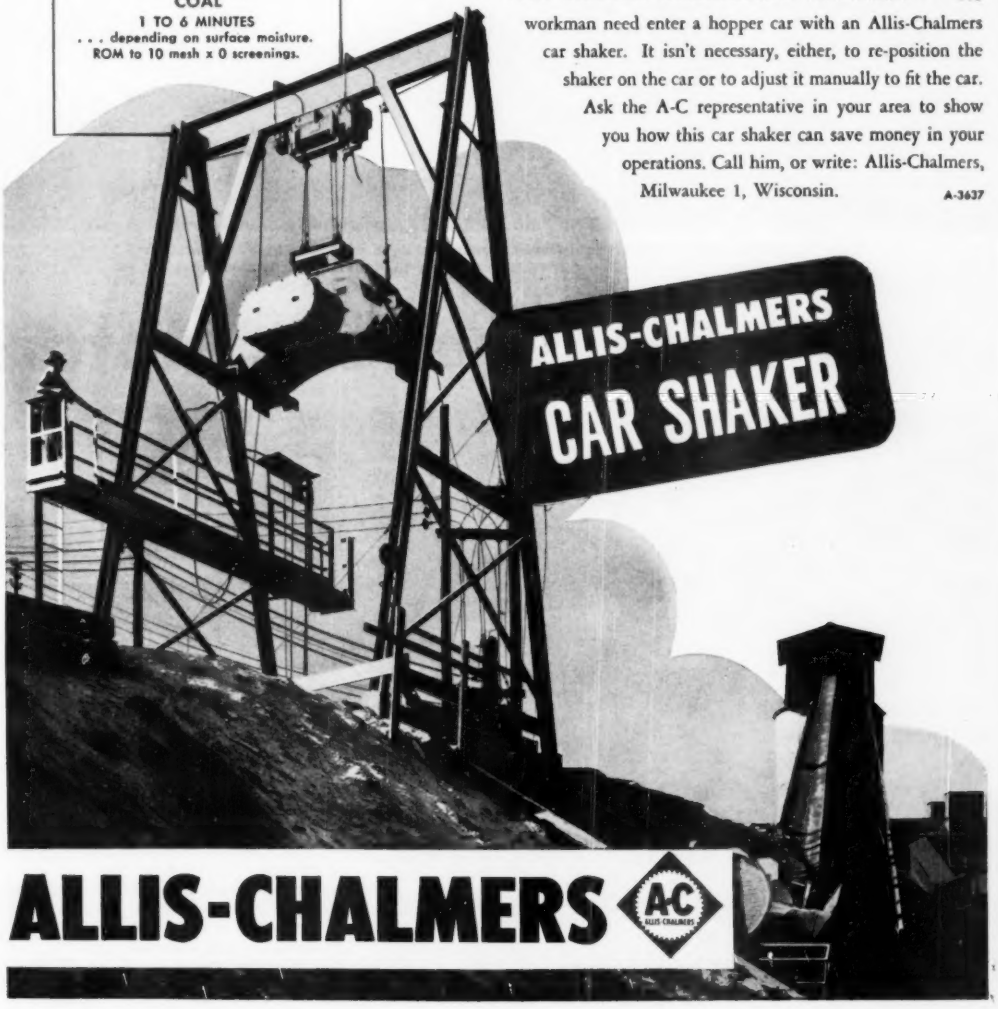
WET SAND
1½ TO 2¼ MINUTES.

ROCK
½ TO ¾ MINUTES
. . . ½ to 6 in. crushed material.

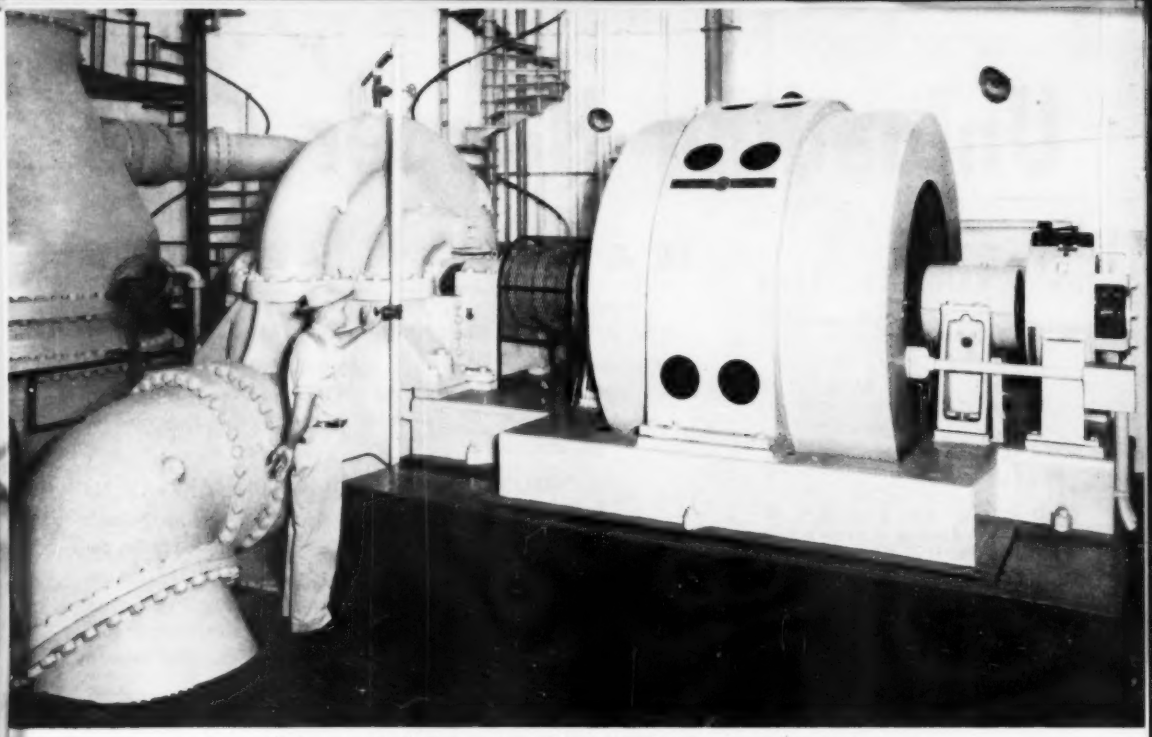
COAL
1 TO 6 MINUTES
. . . depending on surface moisture. ROM to 10 mesh x 0 screenings.

YOU CUT UNLOADING COSTS . . . Push a button and your Allis-Chalmers car shaker will empty a hopper-bottom car in *minutes* . . . and cleanly, too, even if your bulk material is damp, compacted or partially frozen. In addition, it promotes an even flow of material from the unloading station.

YOU REDUCE UNLOADING HAZARDS . . . No workman need enter a hopper car with an Allis-Chalmers car shaker. It isn't necessary, either, to re-position the shaker on the car or to adjust it manually to fit the car. Ask the A-C representative in your area to show you how this car shaker can save money in your operations. Call him, or write: Allis-Chalmers, Milwaukee 1, Wisconsin. A-3637

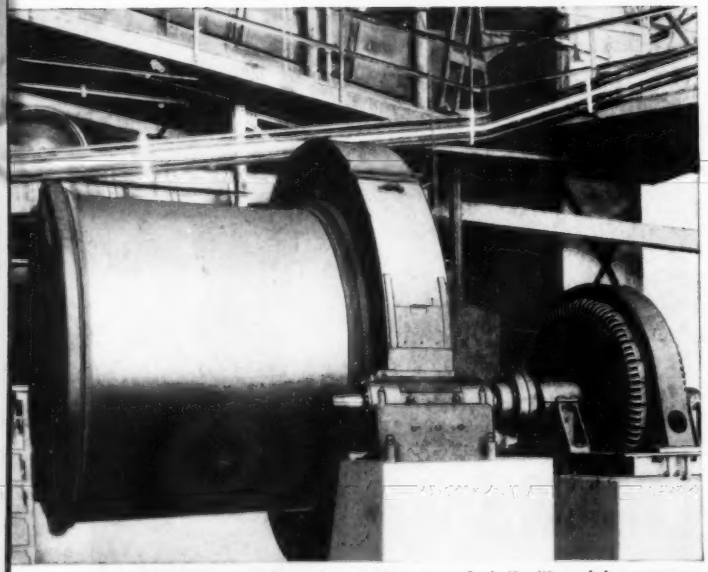


ALLIS-CHALMERS A-C ALLIS-CHALMERS

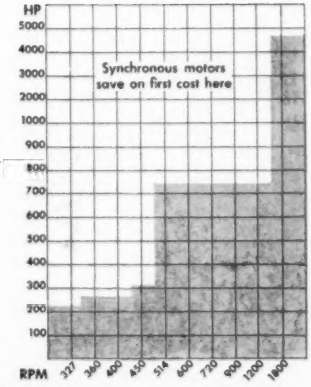


Savings in distribution equipment investment were made possible by selection of this General Electric 2500 hp synchronous motor for a municipal pumping station.

G-E Synchronous Motors

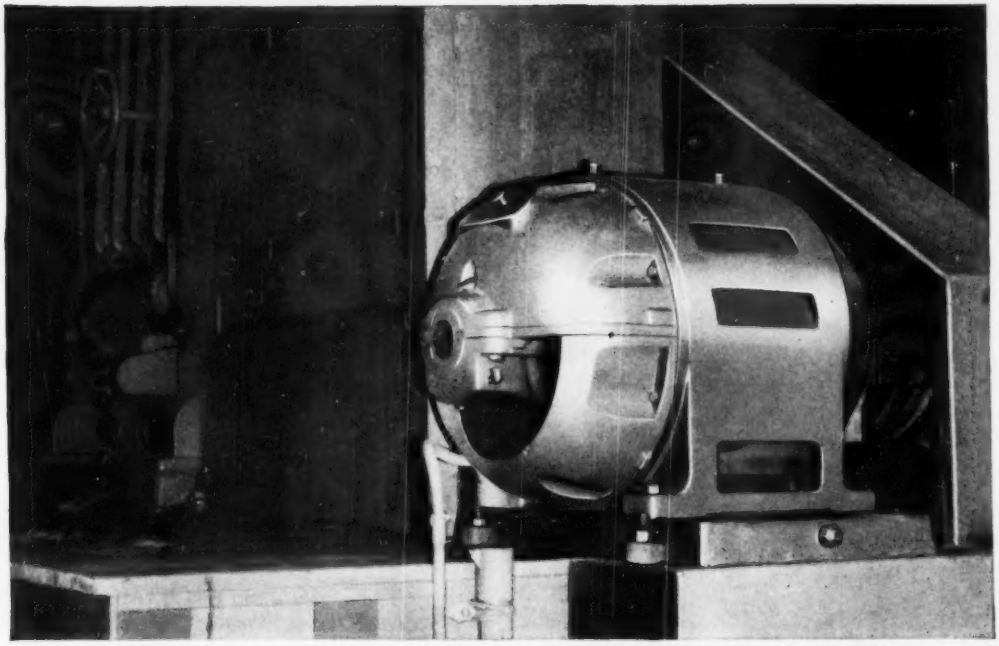


To meet the tough starting requirements of a ball mill, a mining company chose this G-E high-torque synchronous motor rated at 600 hp. Initial cost was low and the motor has given 20 years of dependable service.



Lower first cost of G-E synchronous motors is shown above. For applications in the white area, synchronous motors cost less than any other kind of motor. Calculations below show power savings on a typical 1000 hp, 514 rpm motor.

Gain in efficiency over other types of motors at same rating	**2.2%**
Hourly saving at power rate of $0.01 per/kwh	**$0.184**
Yearly saving (assuming constant operation)	**$1600.00**



Lower operating cost is the rule when General Electric Tri-Clad* synchronous motors are used with equipment such as this horizontal band re-saw, operating almost continuously at heavy loads.

Offer Double Savings

Lower First Costs, Lower Operating Costs Can Be Realized on Large, Constant-Speed Applications in Many Industries

Before you select a drive for a large equipment providing heavy and continuous service, be sure to investigate the economics of General Electric synchronous motors. On many applications such as pumps, compressors, fans, etc., outstanding savings are available.

LOWER FIRST COSTS

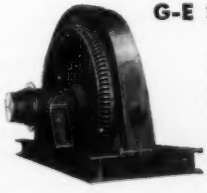
In most ratings where horsepower is equal to or greater than speed, the price tag on a synchronous motor with exciter and control is less than that of any other a-c motor with its control.

And, because a synchronous motor improves plant power factor, initial investment in distribution equipment frequently can be reduced. (The load which any new or expanded power system will carry is proportional to the plant's power factor.)

LOWER OPERATING COSTS

A synchronous motor usually has a higher full-load efficiency than any other type of motor, produces more work per dollar's worth of power consumed. Where loads are heavy and continuous, an advantage of from 0.5 to 3.0% in efficiency pays off.

Engineers with many years of field experience will tailor G-E synchronous motors and control to your job. Call in your General Electric representative—he'll be glad to discuss your particular application. And for more information on G-E synchronous motors, write for bulletins GEA-5332 (low-speed) or GEA-5426 (high-speed) to Section 770-26, *General Electric Company, Schenectady 5, N. Y.*



BE SURE TO SPECIFY G-E SYNCHRONOUS MOTORS

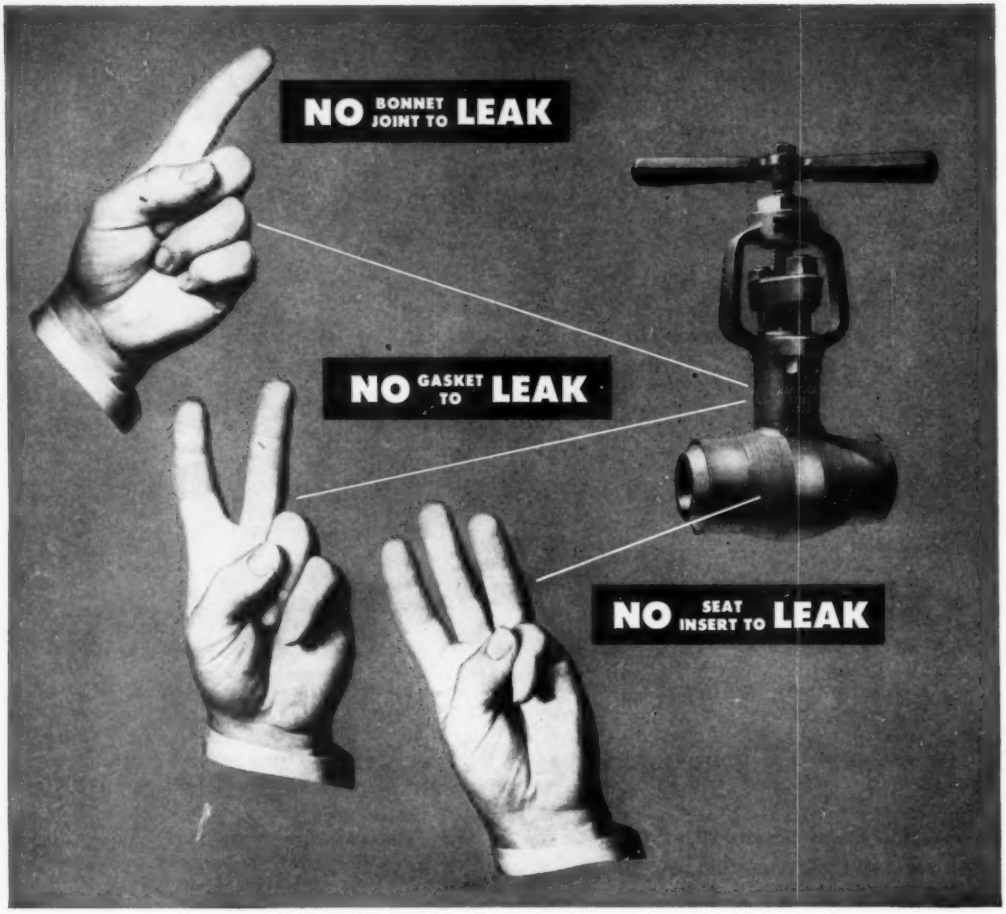
The result of more than 55 years experience in development, manufacture, and successful application, General Electric's line of synchronous motors is available in low speed and high speed types, engine-type and Tri-Clad* construction.

Numerous exclusive design and construction features promote long, dependable service. Get the full details!

*Reg. trademark U.S. Pat. Off.

GENERAL ELECTRIC

770-26



HANCOCK 1500# and 2500# WELDVALVES are designed specifically for high-pressure, high-temperature steam plants – are safe, dependable in the severest service. No bonnet joint, gasket or seat insert to cause trouble. The life of the integral stellite seat and disc is permanent. Self-compensating yoke protects seat and disc against wire drawing leaks and damage. No excess weight to create piping strains – compactness saves space. The valve stays in the line for servicing.

Two valve bodies ($\frac{3}{4}$" and $1\frac{1}{2}$") take care of all pipe sizes from $\frac{1}{4}$" through 2" – simplify inventory and maintenance. Service rating up to 2500# W.S.P. – 1050°F., and 6000# O.W.G. – 100°F.

End the costly hazards of valve leakage. Install safe Hancock WELDVALVES. Call your nearby Hancock Distributor for prompt delivery

When Hancocks go in, valve costs go down

HANCOCK VALVES

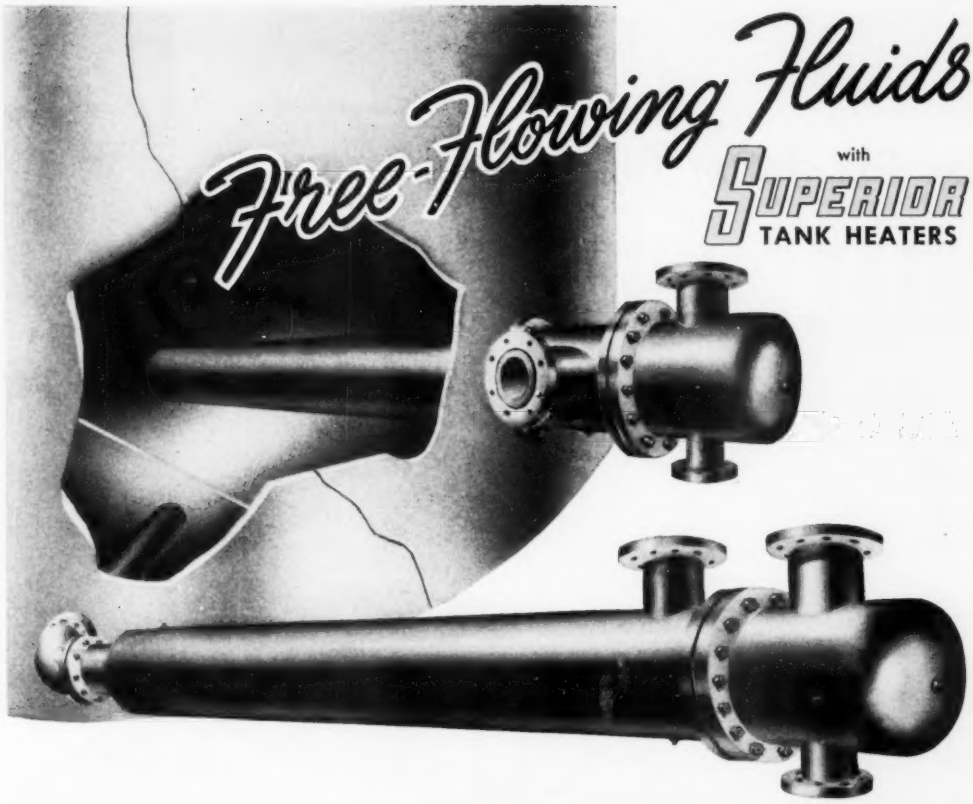
A product of **MANNING, MAXWELL & MOORE, INC.** WATERTOWN 72, MASSACHUSETTS

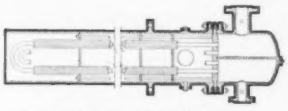
MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

Free-Flowing Fluids

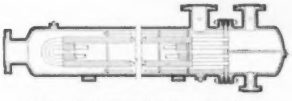
with

SUPERIOR TANK HEATERS





Open-end Type C1U is designed for internal installation . . . applying heat directly at the point of suction.



Type C2U provides for installation exterior to the storage tank. Tubes may be bare, or finned, as required.

SUPERIOR TANK HEATERS are used to heat viscous fluids pumped from storage *without the necessity of heating the entire contents of the storage tank.* With steam, or other heating medium supplied to the "U" tubes, only the liquid withdrawn from storage is heated to the required temperature.

SUPERIOR Heat Exchangers are available in a wide range of sizes and in a variety of shell, tube-bundle, and head designs to meet all conditions of heating, cooling, condensing and evaporating.

Our engineering staff invites your inquiry regarding any proposed installation . . . as a basis for a specific engineering recommendation. For details of construction, write today for fully illustrated Catalog 501.

for performance you can **BANK** *on*

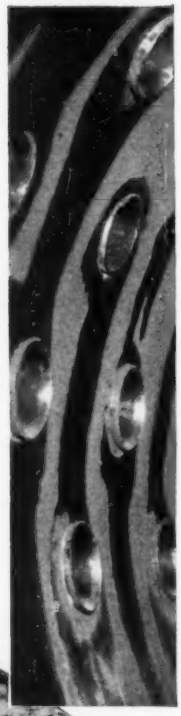
SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

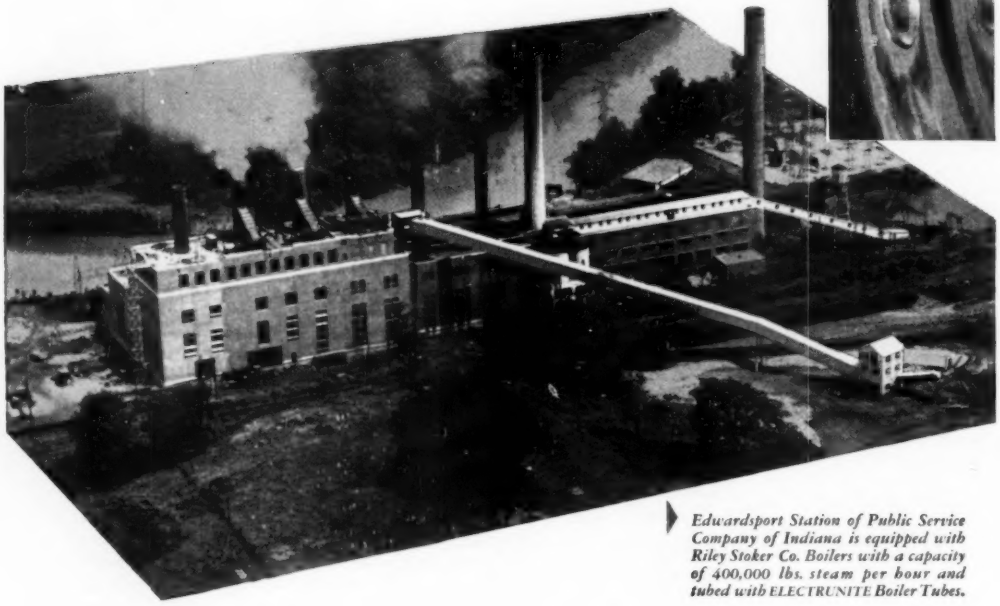
SUPERIOR
HEAT EXCHANGERS

You Get Better Tube Joints Because

ELECTRUNITE TUBES

are Fully-Normalized





Edwardsport Station of Public Service Company of Indiana is equipped with Riley Stoker Co. Boilers with a capacity of 400,000 lbs. steam per hour and tubed with ELECTRUNITE *Boiler Tubes.*

REPUBLIC STEEL CORPORATION

STEEL AND TUBES DIVISION

224 EAST 131st ST. • CLEVELAND 8, OHIO

Full-normalizing gives ELECTRUNITE Boiler Tubes the uniform structure that helps provide extra years of trouble-free service.

TUBES FIT tube-holes snugly ... joints roll-in tightly ... tubes resist corrosion longer when you install ELECTRUNITE Boiler Tubes —the *original* electric-welded pressure tubes.

The surfaces of fully-normalized ELECTRUNITE Boiler Tubes are clean, smooth, and free from scale... tubes are easy to insert in tube-sheets. Full-normalizing assures uniform ductility of the tubes... permits fast, tight roll-in without danger of cracking due to hard spots.

Specify ELECTRUNITE Boiler Tubes ... reduce the incidence of weepers... increase the time between retubings ... reduce boiler maintenance costs.

Republic

REPUBLIC STEEL

ELECTRUNITE

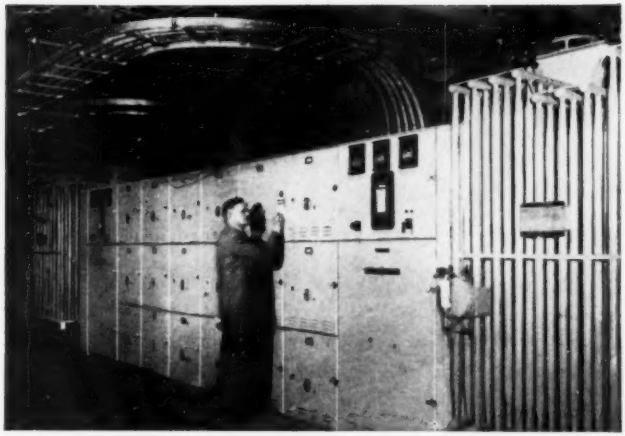
BOILER, SUPERHEATER AND HEAT EXCHANGER TUBES

THE ORIGINAL ELECTRIC-WELDED PRESSURE TUBES

TANK PLANT GETS ROLLING IN RECORD TIME

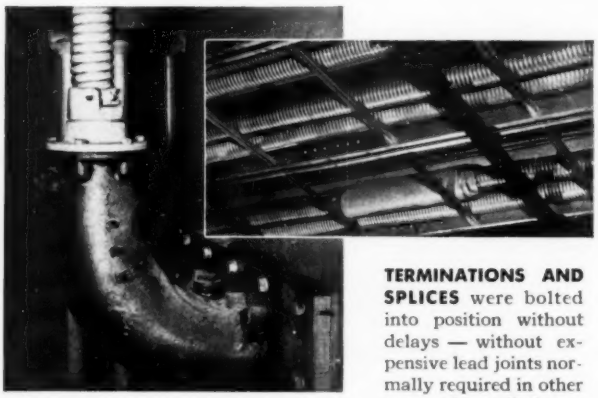
... with

G-E Interlocked Armor Cable

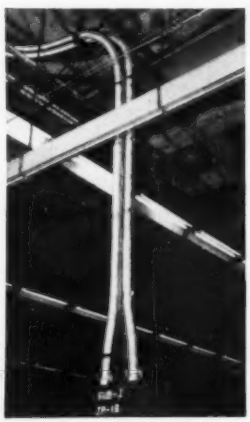


FROM WAREHOUSE TO TANK PLANT in less than a year. That's the latest record of this midwest tank plant. This 53-acre tank plant was sped into production with flexible, adaptable G-E interlocked armor cable installed on Stacey aluminum racks.

INSTALLATION SPEED was a real advantage on main-feeder runs. Racks were quickly hung from ceiling and cables were pulled into place. There was no need to fit raceways and pull cables through.



TERMINATIONS AND SPLICES were bolted into position without delays — without expensive lead joints normally required in other types of installations.



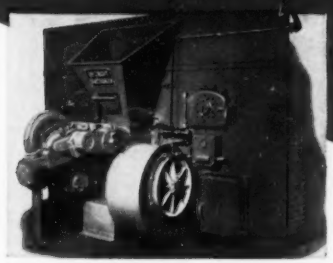
NO THREADING, NO PRE-BENDING required on this run. Hours of bending time were saved on this secondary circuit. Threading and fitting at panel box were eliminated.

COMPLETE DATA ON ADVANTAGES

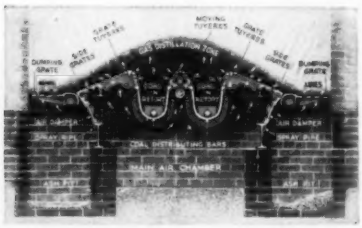
Get the story on installation speed with G-E interlocked armor cables from booklet 19-320. Write Section W11-463, Construction Materials Division, General Electric Company, Bridgeport 2, Conn.

You can put your confidence in—

GENERAL ELECTRIC



DETROIT UNISTOKER Single retort underfeed with Adjustable Coal Feed Control.



DETROIT DOUBLE RETORT A multiple retort—side cleaning underfeed for medium sized boilers. No basement required for ash removal.

for any steam generator (including package types) use DETROIT STOKERS

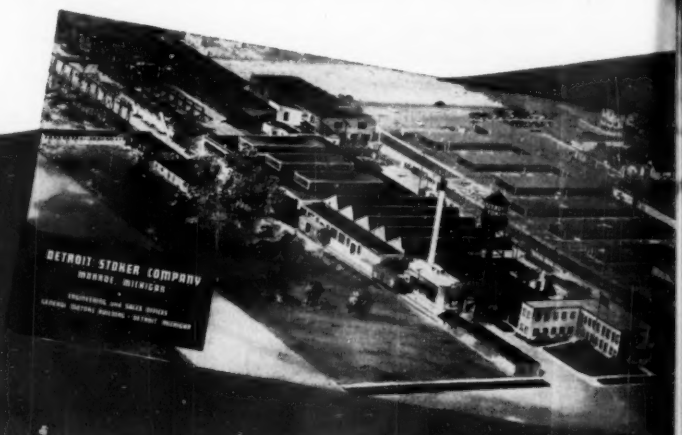
We build stokers adaptable to any type or make of boiler or steam generator. No matter what you are considering we can furnish the ideal stoker—the one that fits the furnace and is best suited to your operating conditions.

Detroit Stokers are successfully operating in thousands of boilers of different types, from firebox heating boilers to large steam generators of over 300,000 pounds of steam per hour, capacity. They are installed in private and public institutions, buildings, industrial and power plants, here and Abroad.

Assembled and Inspected In Our Plant Before Shipment

Each stoker that we design and build is assembled by experts in our plant and carefully inspected prior to shipment. You can't go wrong with Detroit.

Built to outlast the boilers that they serve, Detroit Stokers give you the best, most economical firing method for your needs. An informal discussion with one of our Engineers will cost you nothing and might save you a lot. May we hear from you?



DETROIT STOKER COMPANY

DETROIT SINCE 1898 STOKERS

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

District Offices in Principal Cities . . . Works at Monroe, Michigan

No "Cover" Charge Here!

THE INDUCED-DRAFT FAN MOTORS look pretty small right out in the open air at the base of the towering stacks. But with today's building costs there would have been nothing small about the "cover" charge for brick and mortar walls and a steel-braced roof to house the motors.

Fortunately, modern Allis-Chalmers auxiliary-drive motors need no costly enclosures.

You can count on Allis-Chalmers motors for the kind of operation you need for continuous power generation . . . because A-C has the experience essential to designing and building motors for outdoor use.

For many years, A-C has been supplying splash-proof motors for a variety of outdoor applications. Since 1946, *tube-type* totally-enclosed fan-cooled motors have been available for operation under the most severe conditions indoors or out. And Allis-Chalmers is now offering *weather-protected* motors especially developed for modern outdoor power plants.

Talk Over Your Needs

All three types are available in sizes and speeds to meet all major auxiliary-drive requirements. Your nearby A-C representative can help you select the motors that will best fit your needs for money-saving outdoor installations. Allis-Chalmers, Milwaukee 1, Wis.

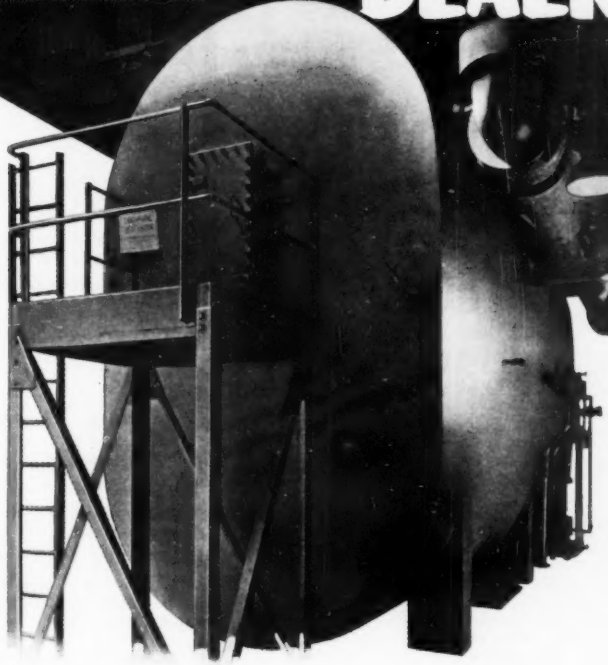
Two 450-hp, 695-rpm, splash-proof cage motors driving induced-draft fans — as well as other Allis-Chalmers auxiliary-drive motors — are installed outdoors at the Natchez Steam Electric Station of the Mississippi Power and Light Company.

A-3653

ALLIS-CHALMERS

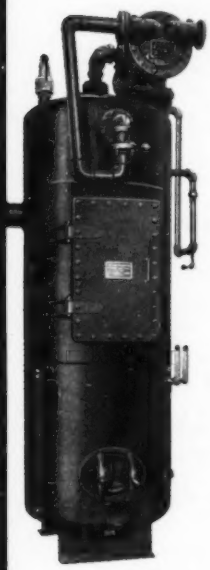
A-C ALLIS-CHALMERS

COCHRANE MULTI-STAGE DEAERATOR



Below is shown one of two Cochrane Multi-Stage Deaerators — capacity 40,000 lb./hr., handling 100% make-up at a prominent public utility station.

At the left is shown a Cochrane Multi-Stage Deaerator, of elliptical design, installed in one of the country's most important electric generating stations. With a capacity of one million pounds per hour, it deaerates returned condensate to zero oxygen (0.005 cc. per liter) before being fed to the high pressure boilers.



COCHRANE originated and for many years has supplied the MULTI-STAGE DEAERATOR for the complete deaeration of 100% cold saturated water and for turbine condensate or other supplies where the difference in water inlet and outlet temperatures may be as small as 20° or 30° F. It is designed as two heaters in series. The top heater is of the jet type and the lower heater of the down-flow tray type. In the jet heater, the water is heated to within a few degrees of steam temperature and the bulk of the non-condensable gases are liberated. The water, with very low oxygen content, passes down to the tray heater where complete heating and deaeration takes place. The first heater acts as a direct contact vent condenser for the second heater, permitting omission of the vent condenser.

Write for a copy of Publication 3005.

COCHRANE CORPORATION, 3106 N. 17th St., PHILADELPHIA 32, PA.

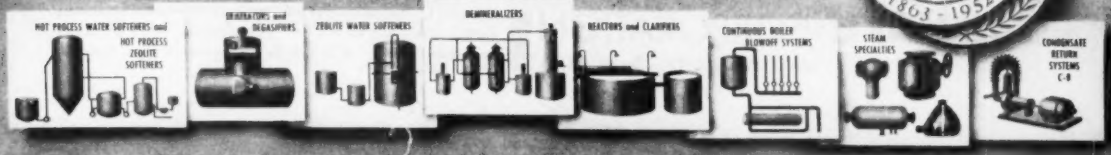
In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City

In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE

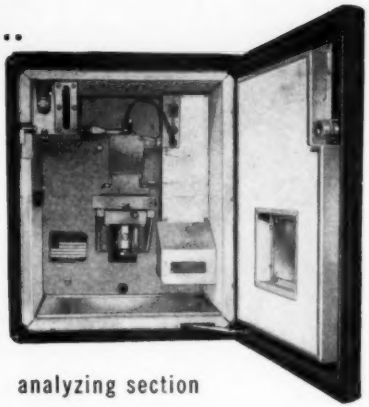
COCHRANE CORPORATION 89 YEARS OF SERVICE 1863 - 1952

PIONEERS AND LEADERS IN BOILER FEED PROCESS & INDUSTRIAL WATER CONDITIONING



for large industrial power plants and central stations...

a new CO_2 RECORDER using three established ideas



analyzing section

Designed to handle the CO_2 measurement problems of large industrial power plants and central stations the new *Hays Condu-Therm CO_2 Recorder* uses three established ideas:

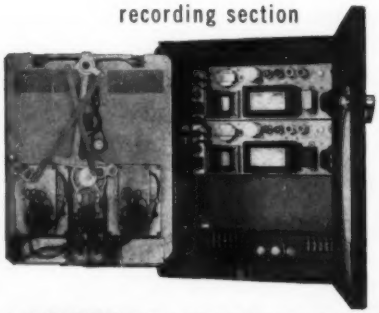
1. *The use of CO_2 measurement as a guide to combustion efficiency* . . . has been used by thousands of boiler plants and industrial furnaces, particularly where a single fuel such as natural gas, oil, bituminous or anthracite coal is being burned.

2. *The thermal conductivity principle of gas analysis* . . . has been accepted extensively in the process industries, because of its fast response to changes in gas composition, its freedom from chemicals, and its proven reliability.

3. *Electronic type operation* . . . frees the instrument of the step action and delicate construction commonly found in galvanometer operated instruments . . . also adds greater speed, power and magnification, while assuring high accuracy and permanency of calibration.

features five second response with ±.25% accuracy

recording section



the condu-therm features:

5 second response to CO_2 change due to:

rapid change of sample gas in gas passage system

small volume of gas in analyzing cell

continuous connection (through amplifier) between analyzer and recording pen motor

- ***±.25% accuracy for chart ranges up to 0 to 20% due to:***

  slide wire construction . . . 5 tolerances held to .1%

  recording pen cam precision-machined to .0001 in.

  high power gain (2.5 million)

- ***"Boiler plant" construction unavailable in any other instrument:***

  linkage of ⅛" x ½" bar

  multiple pen bearing of telescoping stainless steel tubes

  oilite bearings do not require lubrication

  chart plate of ¼ in. permanent mold casting

  unit construction for easy replacement of each main element

For full information on the Hays Condu-Therm CO_2 Recorder write for Bulletin 51-1008 which includes:

detailed explanation of operation of analyzing and recording sections

completely illustrated discussion of component parts and features

drawings of and information on gas sampling systems.

THE **HAYS** CORPORATION

MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

Fireman—First Class

IN HIS TWO RUBBER GLOVES, L P Jernigan, Oak Ridge Operator No. 4317, holds the equivalent of 15,420 tons of coal. He is "stoking" an atomic reactor with slugs of natural uranium, sealed air tight in aluminum cans.

Because the reactor pictured is an old-timer, now used for experimentation only, the heat it extracts from these slugs will be less than 1 percent of the 15,420 tons-of-coal equivalent. And even that will be thrown away in the cooling air. Yet the heat is there in the slugs for anyone who can unlock it.

Let's look at some atomic arithmetic: Each slug pictured contains 2.57 lb of natural uranium. One pound of natural uranium contains 1/140 lb of uranium 235. When U235 is fissioned in a chain reaction, each pound gives up heat equal to 1500 tons of coal.

Even if we "burn" only the U235, each pound of natural uranium equals 1500 ÷ 140 = 10.7 tons of coal. It now appears probable, however, that the process known as "breeding" can convert the entire remaining mass of natural uranium into plutonium—a nuclear fuel as good as U235. When breeding is demonstrated in a pilot plant, which may be soon, each pound of natural uranium in the world will become equal to 1500 tons of coal, and the four slugs pictured will add up to 4x2.57x1500 = 15,420 tons of coal. That's why we rate Jernigan "Fireman First Class," even though the rubber-glove operation shown above may not be a realistic preview of atomic power-plant stoking as it will be done in 1960 or 1970.

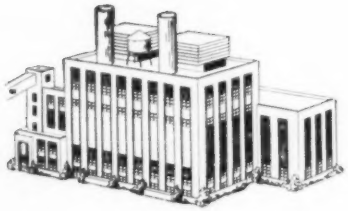
But let's get along with the arithmetic of atomic fuel based on the breeding plants of the future. Suppose highly purified natural uranium then costs, say, $45 per lb—not far from today's average. That will mean paying 4500 cents for the heat of 1500 tons of coal, equivalent to coal at 3 cents per ton.

Incredibly cheap fuel? Yes, but hear the rest of the story before you rush out to buy stock in uranium power plants. Dirt-cheap atomic fuel doesn't necessarily imply cheap atomic power. Remember that tides, winds and sun are "free" energy sources, yet can't compete with coal as power sources. Excessive investment eats up the fuel saving.

Assuming that the atomic plant will cut fuel cost 4 mills per kilowatt-hour, how much more can we afford to invest in the plant, other things being equal? At a 15% fixed-charge rate the 4 mills saving would justify an additional investment of $230 per kilowatt for 100 percent load factor, or $115 for 50% load factor. For years to come, in our opinion, the extra cost of the atomic plant will be much more than $230.

If this estimate is correct, truly competitive atomic power on a large scale is decades away. Meanwhile experimental and subsidized installations on a limited scale may be "just around the corner."

For further details see POWER's editorial in the February issue, "Plain Talk on Atomic Power."

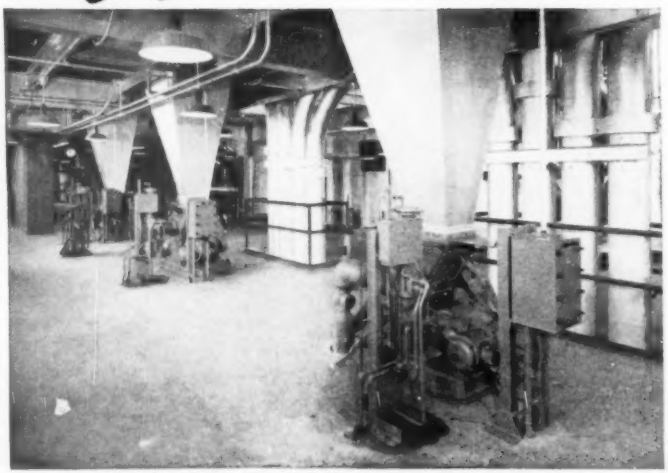


● at the New GADSDEN

Steam Plant of the

Alabama Power Company

Efficiency HAS BEEN



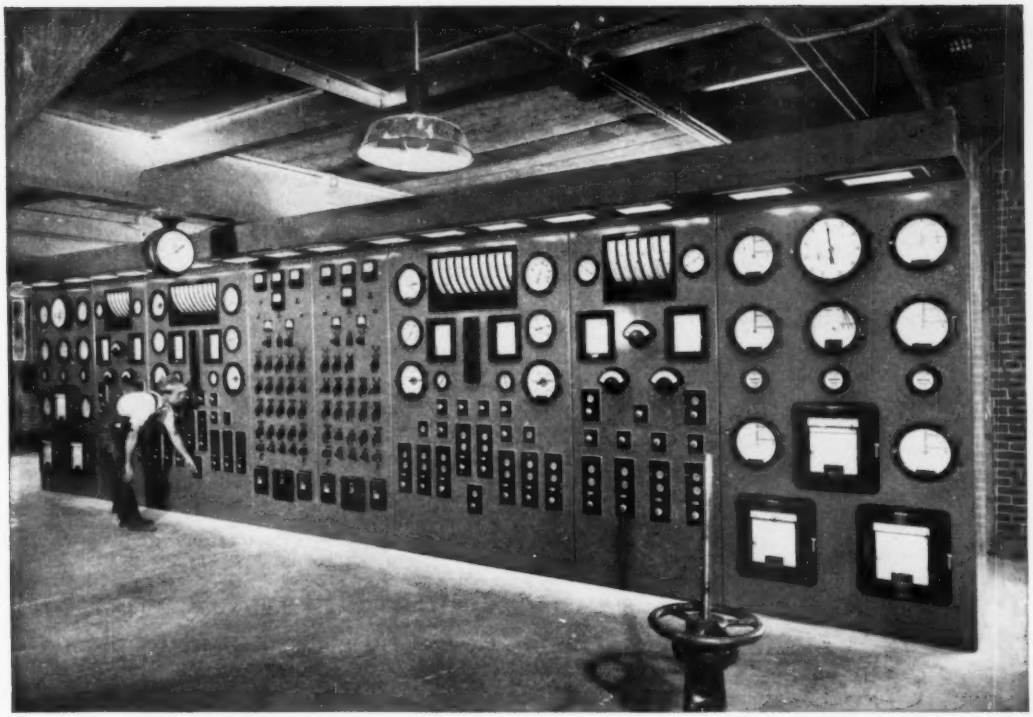
Three of the coal feeders and Republic regulators serving one of the boiler units.

It is the policy of Alabama Power Company to generate, transmit and distribute electricity to its customers at the lowest cost consistent with good service.

When designing the new 120,000 kw. Gadsden Steam Plant, the Alabama Power Company, in keeping with this policy, incorporated proven engineering developments which contribute to economical power generation. High among these was REPUBLIC automatic boiler control.

Two steam generators, each with a capacity of 600,000 pounds of steam per hour, and operated at 875 psig. and 885°F, supply steam to the two turbines. Fuels used are natural gas or pulverized coal, either singly, or in combinations.

The REPUBLIC control board is



On this Republic control board are mounted all gauges, meters and controls for operating each of the two boilers and their auxiliaries.

MADE *Automatic*

made up of one electrical panel, one recorder panel, and two combustion control panels per boiler. All panels are joined together to form one continuous board for the two boilers. The boilers are rubber mounted to reduce vibration, are gray in color, and lighted from an overhead canopy.

The REPUBLIC combustion control system receives its initial impulse from the main steam line through the master controller which establishes a pneumatic loading pressure proportional to the boiler load. The loading pressure is transmitted to the variable speed coal feeders, and to the gas flow valve when burning gas in combination with coal. This pressure is also transmitted to the air flow regulator. A corrector regulator provides means for maintaining the proper steam flow air flow relationship. Provision has also been made for manually adjusting this ratio from the boiler panel.

Air flow and furnace pressure are regulated by hydraulic coupling speed, but fan damper controls are provided for use at extremely low loads, when the fan speed would be reduced below 30% of the motor drive speed.

The boiler feedwater pumps are equipped with REPUBLIC automatic minimum flow hand reset valves. These valves open when the flow through the pumps is 150 gpm or less and by-pass this amount of water to the deaerating heater.

The REPUBLIC feedwater regulator is located on the operating floor and can be manually operated during emergencies from the boiler control panel. The valve control is pneumatic, single element, but the valve is operated by a hydraulic cylinder.

For complete information on REPUBLIC automatic boiler control write for Data Book No. S-21.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

To keep pipe from failing in this tough corrosion course

Genuine wrought iron main and return lines in tunnel installation under railroad tracks.

Genuine wrought iron steam transmission lines.

Villanova College used

BYERS WROUGHT IRON PIPE

In Villanova College, Villanova, Pennsylvania, the job of safeguarding four vital services was entrusted to genuine wrought iron pipe. Over 51 tons of Byers Wrought Iron pipe was used for steam supply, high pressure drip, condensate return and steam transmission lines in the boiler plant and distribution system. The transmission lines fan out from the new boiler plant to feed all the buildings on campus.

The steam transmission and distribution lines provide another impressive engineering endorsement of genuine wrought iron's proved dependability. Because plans called for the installation of these lines under the four track main railroad at Villanova station, the engineers voted for the long-life protection of this time-tested material to avoid the need for premature replacement. George M. D. Lewis was the architect; Gilboy and O'Malley were the consulting engineers; and Philadelphia Mechanical Contractors, Inc. were the contractors.

Boiler plants in every section of the country depend on the durability of genuine wrought iron. In a number of reported cases, genuine wrought iron has doubled, even tripled, the useful life previously obtained from low-first-cost piping material.

Our bulletin, WROUGHT IRON FOR PIPING SYSTEMS, discusses many corrosive conditions and illustrates many places where engineers have successfully applied genuine wrought iron. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of genuine wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

BYERS

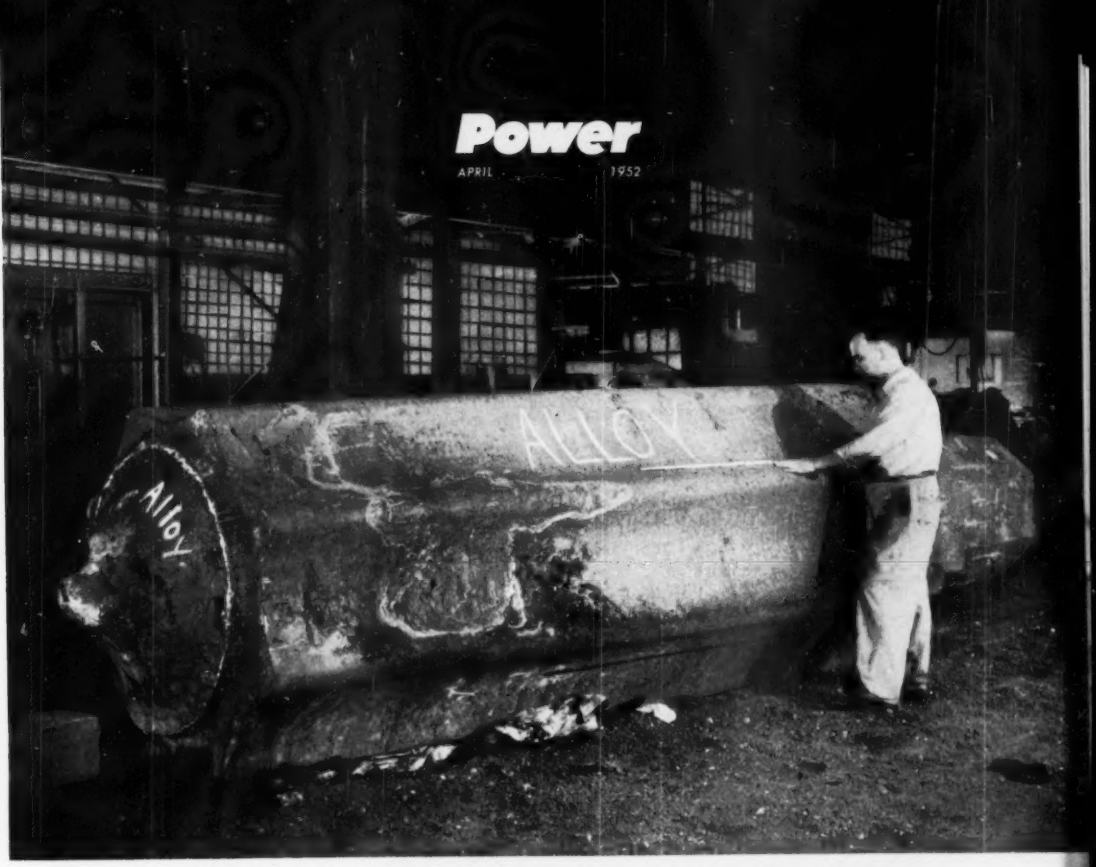
CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Power
APRIL 1952



From this alloy ingot it takes 10 full months of steelworking 'beef' and watchmaking precision to make...

H-P H-T Pipe Dreams Come True

By **DAWSON POWELL**, *Technical Editor, Grinnell Company, Inc*

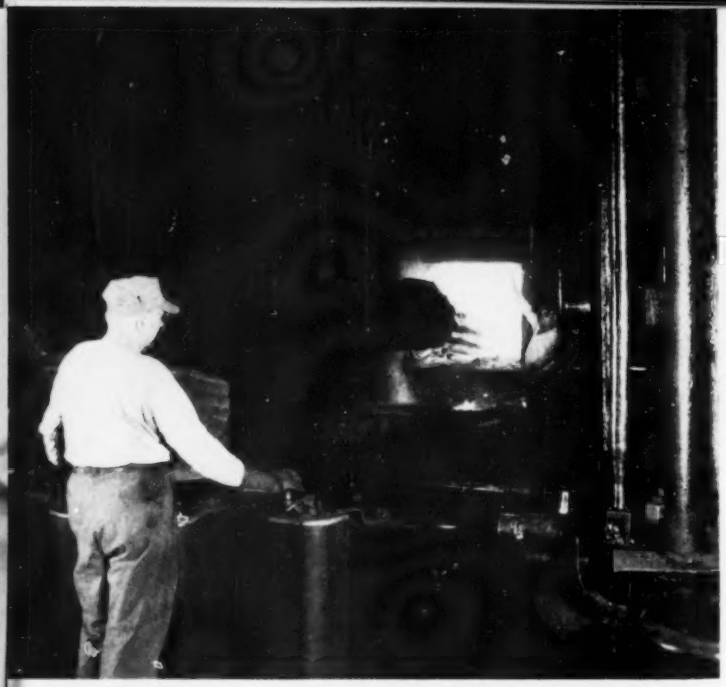
► MANUFACTURE, fabrication and erection of main steam piping for high-pressure high-temperature stations is a big job that starts with about a 20-ton ingot, finishes with gamma-ray tests. Chemist, metallurgist, physicist, radiologist and supersonic electronic scientist are all on the modern pipe fabricator's team.

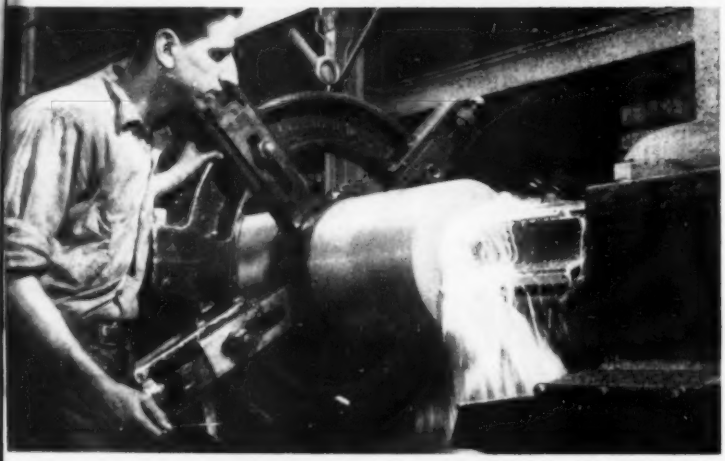
This picture story follows, step by step, only 200 ft of over 52 miles of piping fabricated for Salem Harbor Station of New England Power Co. These 200 ft of main-steam piping convey 1450-psi 1000-F steam to Unit No. 1, rated at 75,000 kw.

Commercial mills can't draw pipe in the materials and sizes needed for this high-temperature high-pressure service. Instead, it must be tailored to the job, forged from huge ingots specially compounded at the steel mill. Piping shown here is 2¼% chrome, 1% moly steel, excellent for high temperatures.

After forging, the solid rod is bored and turned in massive lathes, sizing and finishing being done chip by chip. Then the pipe is bent, tested with supersonic apparatus, stress relieved, welded, stress relieved again. Last step is to use gamma rays to inspect every weld made in the h-p h-t line.

For this story of precise manufacture, split-second bending, extensive testing, turn page



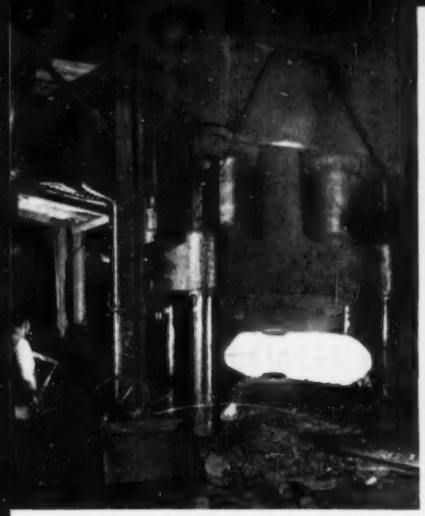


PIPE MANUFACTURE: THIS IS A BIG JOB WITH MICROMETER TOLERANCES

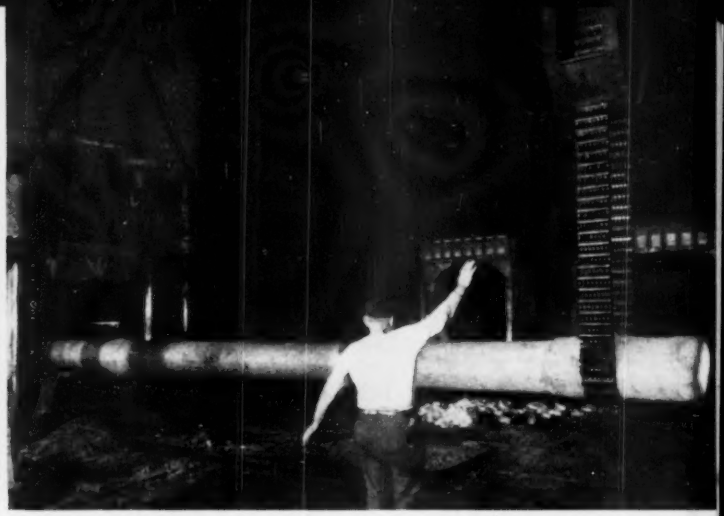
1 **BEFORE FORGING,** ingot is brought to working temperature in oil-fired furnace. Here the ingot is removed

4 **AFTER** the heat treatment, the bar is rough bored from end to end in a giant lathe. ID is now about 10 in

6 **FINISH BORING** brings inside pipe surface to commercial smoothness. This follows rough boring, turning



2 **TWO DAYS'** forging reduces white-hot ingot midsection to about pipe OD. Ingot lengthens as job proceeds



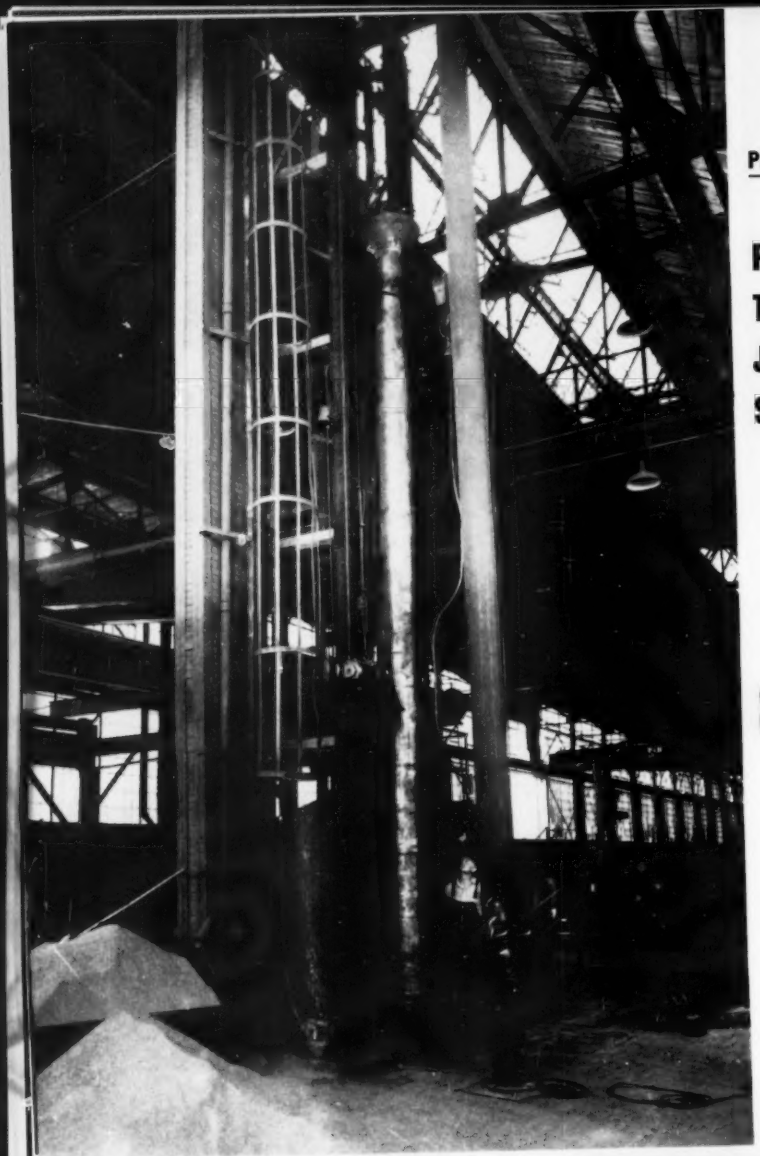
3 **FOUR DAYS'** forging has changed the ingot into this solid bar that is over 30 ft long; outside diameter is 15½ in. From the forge the bar is moved to a heat-treating furnace for slow cooling and preliminary heat treatment

5 **TURNING** after rough boring reduces wall thickness to 2 in. for straight pipe. Bend sections are made thicker

7 **FLATTENING TEST** in huge press is made on sample cut from each pipe run. This test is only one of many

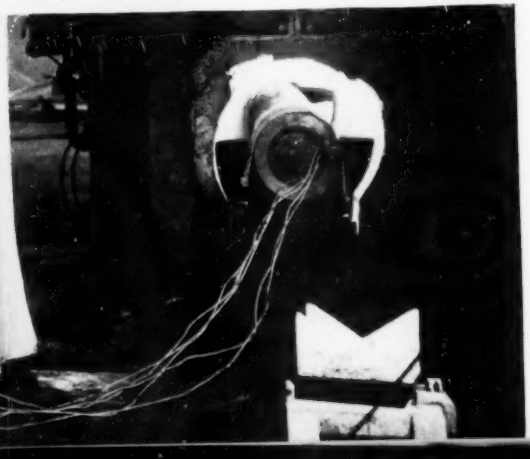
More on next page

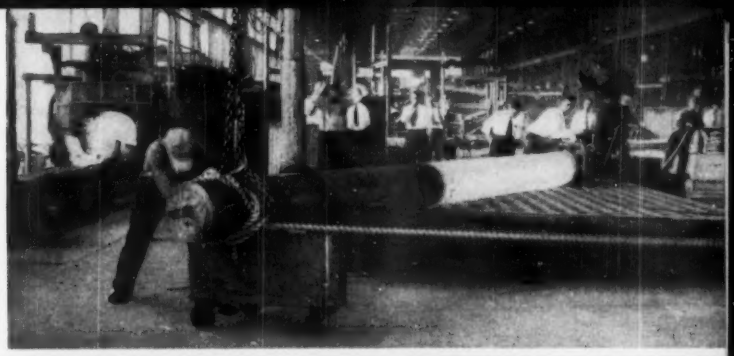
PIPE BENDING: THIS IS A TICKLISH JOB NEEDING SPLIT-SECOND TIMING



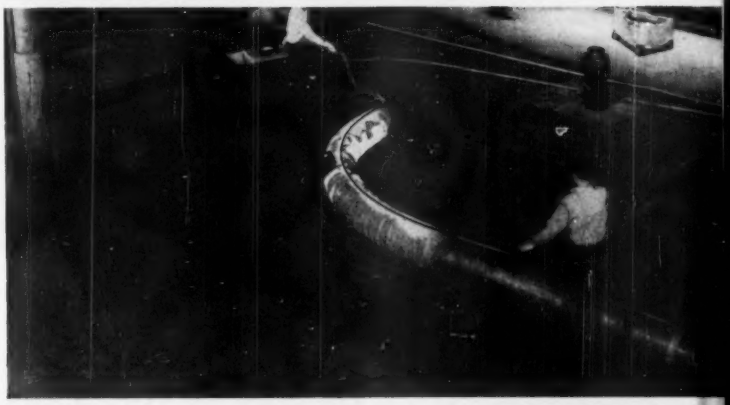
8 **TO PREVENT** flattening while bending, pipe is packed with sand. Air hammer vibrates it, packs the sand

9 **BENDING FURNACE** raises pipe temperature to 2000 F in 3 hr 40 min. Thermocouples, pyrometer check it

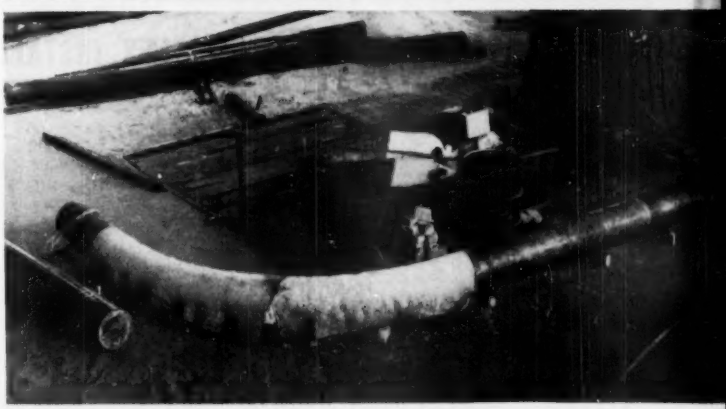




10 **BENDING TABLE** receives pipe from furnace. Bend must be made before pipe temp falls to 1600 F

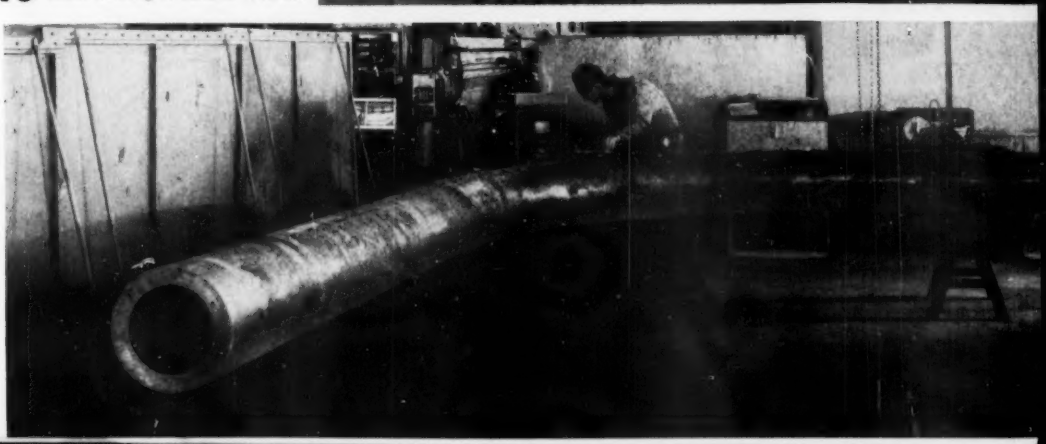


11 **SKILLED TEAM** bends pipe, checks shape with template. Inside surface temp dropped about 100F



12 **SIX MINUTES** after reaching bending table, pipe is blocked up, covered with asbestos for cooling

13 **ULTRASONIC INSPECTION** of wall after cleaning of pipe shows maximum thinning of bend is 1/16 in.



14 **SALEM HARBOR STATION** is still a steel skeleton when installation of steam and other piping begins. Here the main-steam piping, coated with weatherproofing and with ends plugged, waits for installation crew. Before the station goes on the line, miles of piping will arrive from the fabricating plant and move quickly into place, ready for the job

AFTER FABRICATION THE PIPE IS STILL A LONG WAY FROM BEING READY. HERE'S THE COMPLEX INSTALLATION WORK

17 **THERMOCOUPLES,** one for recorder, the other for potentiometer, double check on stress relieving

18 **TAPE** with lead identification letters wrapped on completed, stress-relieved weld; gamma-ray next

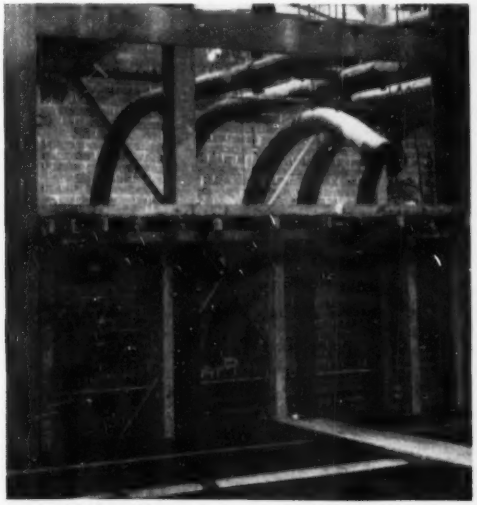
19 **RADIUM CAPSULE,** 50 mg, is inserted in access hole for gamma-ray inspection Capsule radioactive

15 **BEFORE WELDING,** pipe preheated to 550 F. Dc shielded metallic arc using special Grinnell electrodes deposits metal like that in pipe. Welding time per joint is 24 hr

16 **AFTER WELDING,** watercooled induction heating coils are moved together over weld for stress relieving. Pipe held at 1425 F for half hour for each ¼-in. wall thickness

SALEM HARBOR ENGINEERS AND CONTRACTORS

Piping fabricators	Grinnell Company, Inc
Piping manufacturer	Pennsylvania Forge Corp
Piping installation	Hartwell Co, Inc



20 **90-DEG BEND** section of the main steam pipe is temporarily hung in place before final installation. Soon this pipe will be welded, stress relieved, inspected

21 **WELDING OF BEND** follows preheating with watercooled induction-heating coils. Pipe will soon be ready to convey 1450-psi 1000-F steam to station's Unit No. 1

High-Voltage Ac Motor Controllers...Today

Adequate interrupting capacity is of prime importance in the selection of any high-voltage controller. Here are the classes available as outlined by G W Heumann, General Electric Co*

► PRESENT-DAY STANDARDS limit scope of the term *industrial control* to voltages of 5000 or less. Most high-voltage motors in this range connect to power systems having a nominal rating of 2400 or 4160 v.

High-voltage controllers must do the same job as low-voltage units. They must start, stop and protect the motor. Putting it in other words they must make, carry and break the normal starting and running motor current. Motor controllers may be in either Class A or Class E depending on their interrupting ability.

Class A controllers can interrupt ten times rated motor current. This means they can interrupt stalled-rotor current of a squirrel-cage induction motor. Over the years many controllers having this ten-times-rated-current interrupting rating have been installed. They do a good job but have one weak spot. And that has to do with possible short-circuit currents.

Short circuits can occur on any power system. And their value must be considered in the design of electrical equipment. How much short-circuit current may flow through a controller bears no relation to size of motor connected to that controller. It is determined by impedance in the power system plus total connected rotating machinery (both generating and load) which may contribute to the fault current.

Years ago it was considered good practice and ample protection to "back up" branch-circuits to controllers with circuit breakers in substation or power station. These breakers often needed about eight cycles to clear a fault. This back-up protection was adequate as long as system capacities were small, meaning that relatively low currents would flow through the controller on the short circuit.

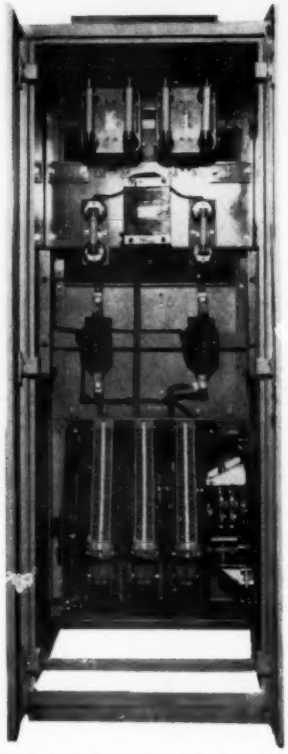
But today the picture is different. Capacity of industrial power systems has grown. Serious damage can result if a Class A controller is in service on a modern system and a short circuit on the load side pulls high fault currents through it. The relatively slow-acting back-up protection permits too big a chunk of short-circuit energy to flow through the controller.

Trend in the industry today is to recognize need for controllers with high interrupting capacity. Then the controller can interrupt faults between the controller and the motor without damage.

Class E controllers have a high interrupting rating. There are two principal types depending on method used for interrupting. Class E1 units use the main controller power contacts for both starting and stopping motor and interrupting short-circuit currents. Class E1 controllers are available with interrupting ratings up to 50,000 kva.

Class E2 controllers use their main contacts for starting and stopping motor; fuses interrupt short-circuit currents. Contactors equivalent to Class A are used in Class E2 since they need interrupt no more than the normal starting currents and the motor overloads.

Fuses that handle short circuits may be (1) power fuses clearing the fault in about one cycle (2) current-limiting type, which interrupts current flow before the initial current peak has been reached. Class E2 controllers are available with interrupting ratings up to 150,000 kva at 2400 v, and 250,000 kva at 4160 v.



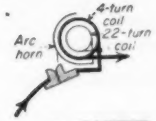
AIR-BREAK Class E2 controller. About same physical size as oil-immersed unit

Under certain high-impedance fault conditions the controller overload relay may trip before the fuse interrupts the fault. So it's necessary to correlate relay tripping time with fuse operating characteristics, and at the same time the contactor must allow for the let-through fault current that the contactor has to carry before the fuse clears the fault.

Interrupting Rating. In calculating interrupting rating of controller connected to system rated 5000 v or less, several assumptions are made: (1) It is customary to neglect impedance of the generators, stepup transformers, transmission lines, and fault current contributions by synchronous and induction motors. (2) An infinite bus is assumed ahead of the stepdown transformers. Then the short-circuit power flowing into the fault is largely de-

*All the basic information in this article was taken from the author's informal conference paper "High Voltage Alternating Current Motor Controllers," presented before the 1951 AIEE fall general meeting in Cleveland, Ohio.

MODERN AIR-BREAK CONTACTORS AND FUSES COPE WITH PROBLEM OF INCREASED SYSTEM CAPACITY



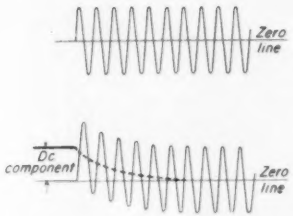
Current carried by the 4-turn blowout coil

Flux from 4-turn coil forces the arc upward

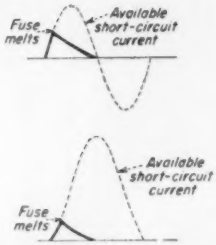
Current now flows in 22- and 4-turn coils

Arc killed fast by the increased field *(below)*

BLOWOUT COIL automatically increases the field strength when arc is on horns



SHORT-CIRCUIT current often "offset" by dc component, as lower sketch shows



CURRENT-LIMITING fuse in high-voltage circuit opens before the peak is reached

termined by the transformer and feeder impedance.

Controller impedance, which would tend to reduce fault current, is a variable, depending on controller size and make. Therefore controller selection is based on the short-circuit current that would flow if the controller were shorted by a zero impedance fault at its line terminals. Short-circuit current thus calculated is the "available" short-circuit current at point of controller installation. Because of simplifying assumptions entering into the calculation the short-circuit current flowing into the fault will be smaller than the calculated value. This simplified method of calculation usually gives good results.

The calculated short-circuit current is a symmetrical current; area of the curve above the zero axis equals area beneath. But in actual practice the short-circuit current may be boosted above the normal zero axis as shown above. It's the dc component of current that offsets the zero axis of the current wave. How big this offset is depends on exactly when in the normal current wave the short circuit occurs. And the rate at which this dc component slides back to the normal zero axis depends on the ratio of reactance to resistance (X/R) in the power circuit.

And here's how all this fits into our picture. When power fuses or circuit breakers are used to clear a short circuit, the current generally interrupted is the symmetrical short-circuit current *plus* the dc component. That's why circuit breakers and power fuses are usually rated in terms of actually interrupted short-circuit power. Such equipment (power fuses and circuit breakers) are applied using a calculated symmetrical short-circuit current multiplied by a given factor. This factor considers the dc component, system characteristic and required interrupting time.

High-Rupturing Fuses. The picture changes somewhat where high-rupturing, current-limiting fuses are used, as with the Class E2 controller. Reasoning is simple; the fuse element opens before peak of the short-circuit current wave is reached. And because of the difference in rate of rise of current, an unsymmetrical short-circuit current is often interrupted at a lower instantaneous value than a corresponding symmetrical current. Hence current-limiting high-rupturing fuses are rated in terms of symmetrical available short-circuit kva they are capable of interrupting.

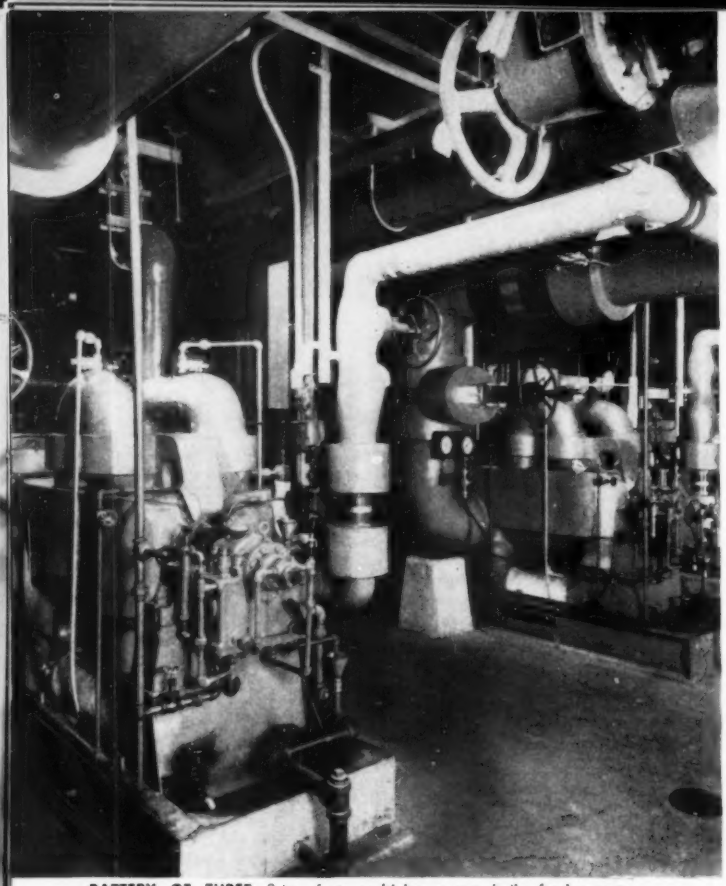
So the first step in application of a high-voltage controller is to know the available short-circuit kva of your power system *at point of controller installation*. Manufacturers rate Class E1 and E2 controllers in terms of available symmetrical short-circuit kva.

Oil or Air? Class E controllers are available with either oil-immersed or air-break contactors. In an oil-immersed type all arcing parts are enclosed in an oil tank. Often the contacts have no blowout or arc chutes. Oil is relied on to quench the power arcs. Most important advantages of oil-immersed contactors is the explosion protection the oil gives when equipment is installed in hazardous locations. And there are disadvantages too.

Biggest is the maintenance angle. Any insulating oil will carbonize and sludge in time. This means cleaning contactor parts and renewing oil at regular intervals. And the maintenance picture includes checking any oil leaks that may develop. Experience over the years has shown that contacts arcing under oil have shorter life than contacts arcing in air. This is a distinct handicap when motor is started and stopped often.

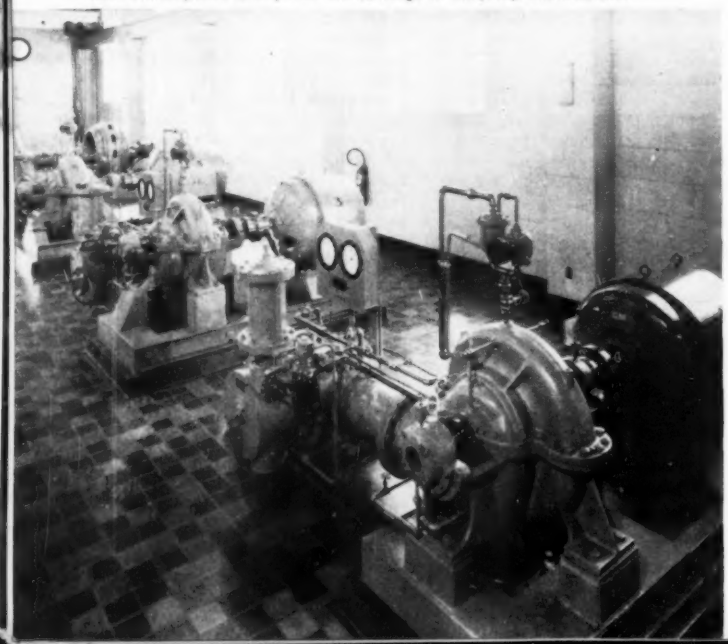
Air Break. Blowouts and arc chutes come into the picture with air-break contactors. Possible fire hazard from oil is eliminated, maintenance simplified and contact life increased. For years air-break contactors have been preferred on controllers for frequent starting and stopping of motor especially where jobbing is involved.

Most significant feature of modern high-voltage air-break contactors is the design of their arc chutes and associated parts. Current interruption takes place entirely within the arc chute with little if any flame emitted. For this reason it is possible to reduce spacing between phases and between contactor and adjacent parts. It's this evolution in design that allows fitting air-break contactors into the same space that is needed for the oil-type contactors.



BATTERY OF THREE 8-in. 6-stage high-pressure boiler-feed pumps for 1070 gpm, 1150 psi, can run in parallel over entire capacity range

WATERWORKS PUMPS run in parallel on a throttled system. But operation in most plants is only over limited range of the pump characteristics



If two pumps run in parallel on a throttled system, their head - capacity curves should rise to shutoff, they should deliver some capacity over operating-head range. Here's how to use pump characteristic curves for safe paralleling

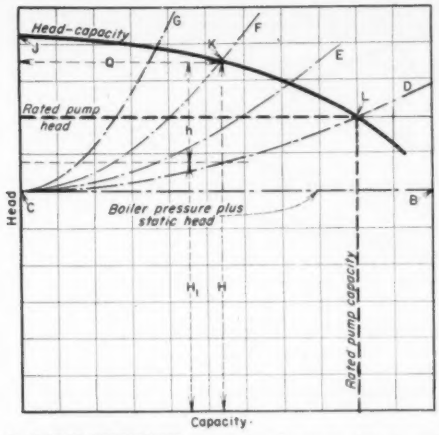
By **ROY CARTER**
and **IGOR J KARASSIK**
Application Engineers
Worthington Pump and Machinery Corp

Study Your

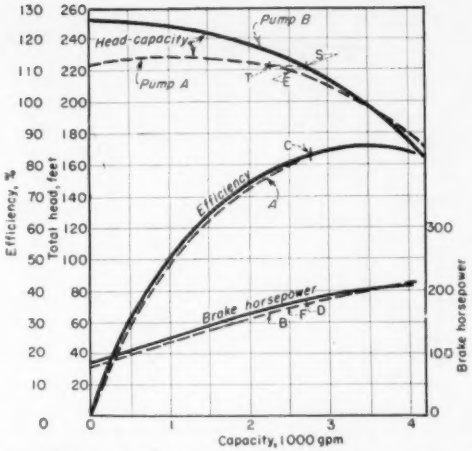
► PUMPING SYSTEMS fall into (1) throttled and (2) unthrottled. In (1), flow is controlled by throttling with one or more valves the excess head developed by pump or pumps. On some systems, like boiler-feed, a throttle valve directly in the discharge line controls flow. In others, such as city-water supply systems without a standpipe or reservoir floating on the distribution mains, the water users control pump discharge as they open or close valves to suit their needs. In (2), unthrottled systems, where pumps discharge into a standpipe or reservoir, flow depends on head they develop and normal characteristics of system. Here, we will consider throttled systems only.

Boiler-Feed Pumps. Fig. 3 is a simple boiler-feedwater hookup whose flow is controlled by throttle valve *A*. This valve can be positioned by hand or automatically by a feedwater regulator. Fig. 1 shows the feedwater-system head curves superimposed on the pump's head-capacity curve. On these curves line *CB* represents boiler pressure plus the static pressure in the pumping head. This pressure is practically constant varying only with slight changes in boiler pressure.

When water is supplied the boiler by the pump, pressure against which it operates increases because of friction-



1 **BOILER-FEEDWATER** system head curves plotted on feed-pump head-capacity curves show capacities pump runs at



2 **TWO PUMPS** with unlike head-capacity curves may operate in parallel but problem is different from one for like units

Centrifugal Pumps Before Paralleling

head losses in piping, fittings, valves and other devices in the line. With valve *A*, Fig. 3, open, we can assume that pressure due to friction losses increases along curve *CD*. This curve crosses the pump head-capacity curve at point *L*, which is the rated head and capacity of pump.

Partly closing valve *A* increases friction head and system's head curve might rise to position *CE*. Further closing of valve *A* would produce other head curves like *CF* and *CG*. If valve is closed completely, pump pressure goes to shutoff at *J*. Then, by opening valve *A*, head curve can be varied so it appears as a family of curves, representing a fully closed valve at *J* and an open valve at *D*.

With head-capacity curves for a boiler-feed pump as in Fig. 1, to supply the boiler with a quantity of water, *Q*, throttle valve is adjusted until system's head curve is *CF*. This curve crosses the head-capacity curve at *K* and head against which pump operates is represented by vertical distance *H*. Actual head required to deliver quantity *Q* to boiler on normal head curve *CD* is represented by H_1. As pump develops head *H* at capacity *Q*, valve *A* will have to throttle away a head equal to $H-H_1$ or *h*.

Rising Head Curves. When two like pumps with steadily rising head-capacity curves operate in parallel, system load should divide equally between them. Fig. 4 shows the head-capacity curve of either of two like pumps. To draw this curve for the two pumps operating in parallel we need only project capacity points at various heads on the curve to the right to double their value. For example, point *A*, 1000 gpm at 244-ft head, is extended to the right to 2000 gpm and 244-ft head, point *B*. The 2000-gpm intersection *C* is projected to 4000 gpm, point *D*, and in like manner 3000 gpm is projected to 6000, and 4000 to 8000 gpm, as horizontal dotted lines indicate. Curve drawn through these points is head-capacity characteristic for the two pumps. Each pump is rated 3500 gpm at 197-ft head, point *E*, so two pumps are good for 7000 gpm and the same head, point *F*, on the 2-pump curve shown in Fig. 4.

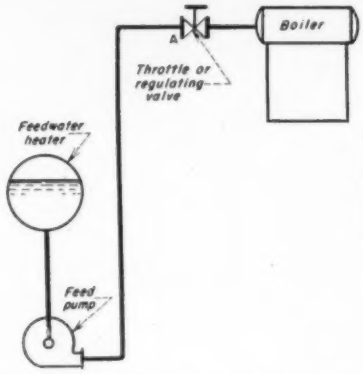
Power input to the two pumps is about 400 hp, point *G* on the horsepower curve for two pumps. This curve was plotted by doubling the horsepower for one pump and doubling the capacity. For example, at 1000 gpm, the power is 125 hp for one pump, point *H*. So for two pumps it is 250 hp at 2000 gpm, point *J*. Repeating this procedure at different capacity values we get a series of points through which the 2-pump power curve is drawn.

If these two pumps operate on a throttled system and demand decreases, they must deliver less capacity. As a result, head developed increases and more throttling is necessary. For example, if demand decreases to 5000 gpm, head developed increases to 227 ft, point *K*, and power required is 356 hp, point *L*. Each pump delivers 2500 gpm against 227 ft and requires 178 hp, point *M*.

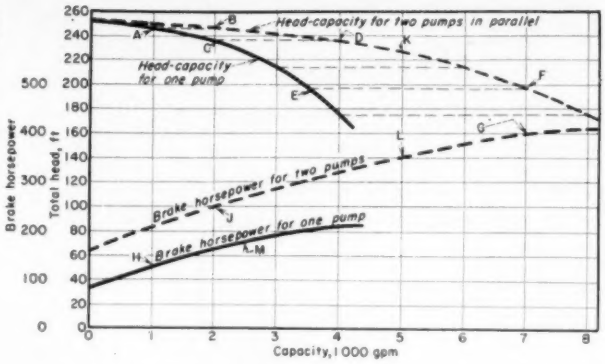
Unlike Characteristics. Two unlike pumps can operate in parallel, but they present different problems from two that are alike. Let's study the two units whose characteristics are shown by full-line and dotted curves, Fig. 2. Either can be used alone on a throttled system. If power cost is high, pump with dotted curve would be preferred because its power at part capacities is slightly lower.

Don't infer that of two pumps the one with flatter head-capacity curve takes less power at part capacities, because this is not always true. Input depends on impeller and casing design, relation of design point to maximum efficiency, and other factors. So a pump with a steep head-capacity curve may take less power at part capacities than one with a flatter curve. But a unit with a steep

BY PLOTTING THE COMBINED HEAD-CAPACITY AND HORSEPOWER CURVES FOR CENTRIFUGAL . . .



3 **SIMPLIFIED DIAGRAM** of a boiler feedwater system hookup with a manually or automatically controlled valve at *A*


Head-capacity for two pumps in parallel
Head-capacity for one pump
Brake horsepower for two pumps
Brake horsepower for one pump
Brake horsepower
Total head, ft
Capacity, 1000 gpm

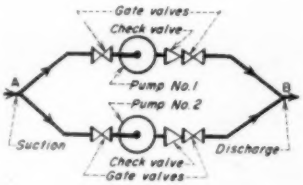
4 **HEAD-CAPACITY** and brake-horsepower curves for two like pumps and combined curves for the two pumps in parallel

head-capacity curve, full line Fig. 2, has the advantage in a single-pump throttled system requiring a greater travel of the throttling valve, because more head has to be lost across valve. Operation is more stable.

Drooping-Head Curve. In spite of having a drooping head-capacity curve, dotted line Fig. 2, this pump can usually be used on a single-pump throttled system as operating point is determined by throttled-system head. On some throttled systems with a single pump having a drooping head-capacity curve, flow surging may occur. This has also developed to a less degree with pumps having a stable, constantly rising head-capacity curve, full line Fig. 2, but such cases are rare.

When two or more pumps operate in parallel, Fig. 5, each has its own piping and fitting losses as well as losses common to both. Instead of using the true head-capacity curve, use one measured from *A* to *B* in system study. This is the true characteristic of the pumps minus piping and fitting head losses from *A* to *B*. Usually in throttled systems, particularly in high-head applications like boiler-feed, losses in each pump's piping are such a small part of total head, they may be neglected.

Combined Head Curves. Fig. 6 shows characteristic curves of two pumps, each designed for 3500 gpm, 197-ft total head, point *N*, but with different-shaped head-capacity curves. *A* and *B* are head-capacity curves of the two pumps; *C* is the combined head-capacity curve. This curve includes values from *D* to *E* on curve *B* to which is added curve *A*, and extends from *E* to *F*. Point



5 **SIMPLIFIED PIPING** hookup for two centrifugal pumps run in parallel

G on curve *A* is at 0 gpm, while *E* on *B* is at 2650 gpm, with 223-ft head on both curves. Combined capacity of the two pumps at 223-ft head is 0 + 2650 =2650 gpm. Point *H* on curve *A* is at 228 ft and 1000 gpm. To get a corresponding point for curve *C* we go to 2450 + 1000 = 3450 gpm and 228-ft total head.

At 2000 gpm on curve *A*, point *K*, the head is 224 ft. Again, to get a corresponding point for curve *C* we go to 2600 + 2000 = 4600 gpm and 224-ft head, point *L*. Repeating this operation we get a series of points through which curve *C* can be extended to represent the combined characteristics of the two pumps. Construction of this curve is the first step in finding how two pumps with unlike head-capacity curves perform on the same system.

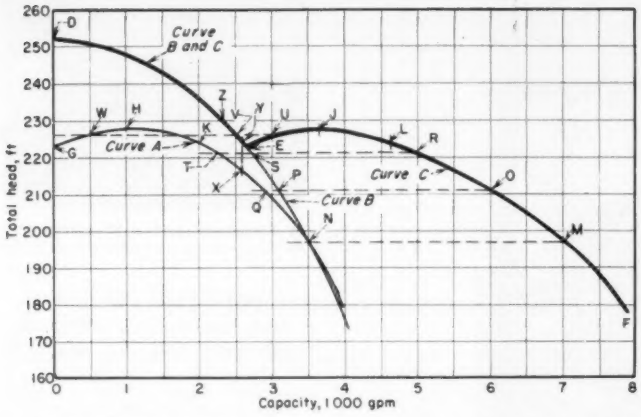
Waterworks Plant. Assume these pumps are in a waterworks plant discharging directly into a distribution system at a normal total head of 197 ft. At this head the two pumps discharge 7000 gpm, point *M*, where both have the same capacity, point *N*. If flow in system falls to 6000 gpm, point *O*, the two pumps develop 211-ft total head. Under this condition, pressure in main is 211–197 = 14 ft, or 6.06 psi higher than desired. This is something that must be accepted unless speed adjustment controls pump output. Of the 6000-gpm discharge, 3100 gpm is supplied by pump *B*, point *P*, and 2900 gpm by *A*, point *Q*.

When points of total discharge and head are determined on curve *C* to find division of load between two pumps, project horizontally to left from *C* to intersect curves *A* and *B*, as indicated by dotted line from *O* to *Q*.

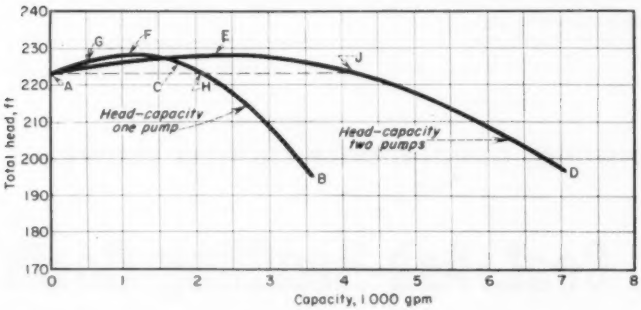
If flow from system decreases to 5000 gpm, total head increases to 221 ft, point *R*. Projecting to the left from *R* we intersect curve *B* at 2730 gpm, point *S* and *A* at 2270 gpm, point *T*. On reduction of discharge to 3000 gpm, point *U*, head goes to 226 ft. Discharge of *A* drops to 500 gpm, point *W*, and to 2500 gpm on *B*, point V.

If system head is throttled to 230 ft, discharge drops to 2350 gpm for pump *B*, point *Z*. *A* won't discharge because system head has increased above the maximum 227 ft, point *H* for this unit. Pump *A* is therefore "backed off the line" by *B*, and operates at shutoff, a dangerous condition even for a short time. The two pumps should not operate in parallel at a cacapity below a safe minimum.

Load Division. Assume *A* operating alone and discharging 2600 gpm, at 216-ft head, point *X*, when *B* starts. The lat-



6 **CHARACTERISTIC CURVES,** individual and combined, for two pumps, each designed for 3500 gpm at 197-ft total head, but having different head-capacity



7 **TWO SIMILAR** centrifugal pumps having drooping head-capacity characteristics can give operating trouble when connected in parallel on a throttled system

ter has a head-capacity curve higher than *A* and picks up the load to back *A* off the line. If flow in system stays constant at 2600 gpm, the head rises to 224 ft, point *Y*. On the other hand, if *B* had been discharging 2600 gpm alone and *A* had started, *A* could not have supplied any water to the system.

Suppose these pumps operate on a system where the demand changes slowly and one unit is taken out of service when the load falls below 3500 gpm. Under careful supervision the two could operate safely in parallel. At 5000 gpm combined flow, *A* discharges 2270 gpm at 221 ft head, point *T*, Fig. 2 and 6. Efficiency is 76.8%, point *A*, power input 165 hp, point *B*. Pump *B* discharges 2730 gpm, point *S*, Fig. 2 and Fig. 6, with an efficiency of 82.3%, point *C*, and 185 hp, point *D*. Total power for the two pumps is 165 + 185 = 350 hp.

If both pumps were like *A*, a flow of 5000 gpm would take 2500 gpm from each unit, point *E*, Fig. 2, and 173 hp per pump or 346 hp for the two. With both pumps like *B* the power for each is 178 hp, point *F*, or 356 for two pumps. In one case, with two units alike, power is less than for two unike pumps, while in the other it is greater. This shows that having both pumps alike so load divides equally between them may not result in a driving-power reduction.

Drooping-Head Curve. Two similar pumps with drooping head-capacity characteristics, dotted curve, Fig. 2, can give trouble when operated on a throttled system. Curve *AB*, Fig. 7, shows head-capacity characteristic of either of two like pumps operated in parallel. Curve *AD* is theoretical combined head-capacity relation of the two. This curve is developed as explained in Fig. 4, assuming friction losses so low in each pump's piping they can be neglected.

Assume a water demand of 1750 gpm and 226-ft head, point *C*, with No. 1 pump operating alone, when No. 2 starts. Pump No. 1 operating at 226-ft head applies this pressure to check valve of pump No. 2 to hold it closed. This is greater than the shutoff head, 223 ft, point *A*, of pump No. 2. Thus, this pump when it comes up to speed on shutoff, can develop only 223-ft head, not enough to open the check valve against 226 ft, and it cannot discharge into the system.

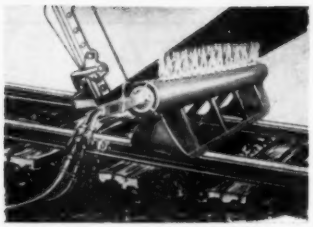
Several tricks overcome this difficulty. Consider the two pumps, Fig. 5, with No. 1 operating at 1750 gpm. By throttling the discharge valve of this pump, pressure at *B* and on the check valve of No. 2 can be reduced below the shutoff head of this pump. Then, when it is started it can open check valve and take part of the load. This and other tricks to get second pump on system generally require careful handling of valves and timing.

Division of Flow. With two pumps having drooping head-capacity curves, Fig. 7, flow may not divide equally between them even if they are hydraulic duplicates and operate at the same speed. For example, to supply a demand of 2250 gpm, point *E*, load could be divided equally with the two operating at 1125 gpm and 228-ft head, point *F*. Or under this condition one pump may operate at point *C*, 1750 gpm, and the other at 500 gpm, point *G*. Heads at these points are equal, but this does not insure stable operation.

It is not good practice to operate in parallel two pumps with drooping head-capacity curves, Fig. 7, at capacities at which head exceeds shutoff. In Fig. 7 this is 2100 gpm and 223-ft head for one pump, point *H*, or 4200 gpm and the same head, point *J*, for two. When the two operate at this or a greater capacity, they are on the stable part of their head-capacity curves and divide flow about equally. Also, one pump cannot take all load and shut off the other.

Operating Requirements. For two pumps to run in parallel on a throttled system they should: (1) have head-capacity curves that rise steadily to shutoff (2) have the same percentage reduction in capacity over their possible operating-head range or at least deliver some capacity. Usually, two or more units with stable head-capacity curves and about equal shutoff heads, share load nearly equally at their lower capacities.

1 Movable car shaker complete with hoist or dolly can empty car "broom clean" in under 15 min



2 Frozen coal need be no problem. Just use portable car-thawing units above

I: LABOR COSTS PER TON OF COAL CONSUMPTION BASED ON $3600 WAGE RATE PER MAN-YEAR

Tons coal used a yr	*1 extra man, $*	*2 extra men, $*	*3 extra men, $*
1,500	2.40	4.80	7.20
6,000	0.60	1.20	1.80
10,000	0.36	0.72	1.08
15,000	0.24	0.48	0.72
20,000	0.18	0.36	0.54
30,000	0.12	0.24	0.36

Balancing fixed, operating, maintenance charges shows...

How to Bring Coal, Ash-Handling Costs

► No longer need coal and ash handling make the use of solid fuel objectionable. There's plenty of proved equipment on the market that gives coal the clean, labor-saving convenience of its competitors in all sizes of plants.

Because so much equipment is available a certain amount of confusion is bound to develop in its selection and coordination. Many plants avoid this confusion by calling in experienced consulting engineers. Results indicate real advantages for the well-integrated coal-fired boiler plant. But the major problem today is not just clarifying these advantages but also simplifying selection of equipment.

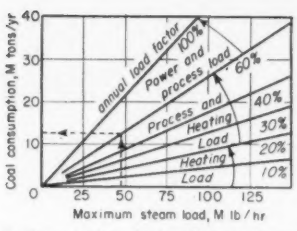
One suggested way out is to establish standardized design patterns for plants with comparable coal consumption. And the idea offers rich possibilities. Behind any plan, though, there has to be a balance between economy in fixed charges and those for labor and maintenance. What's more, the selected installation should promise definite boiler-room efficiencies.

Investment Costs. All considerations of required equipment capacities and handling costs must come from rate of coal consumption and not steaming capacity. Fig. 3 offers a quick check on coal rates for a new plant under designated load factors. (Load factor is percent of maximum steam load—not boiler capacity—representing average steaming rate for full 8760 hr per yr.)

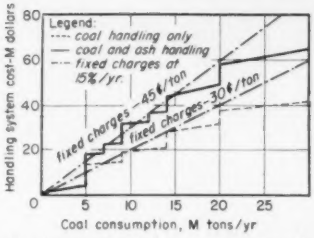
Fig. 4 shows typical erected costs of handling systems recommended for various sizes of plants. Note that total fixed charges do not exceed $0.45 or $0.50 per ton of coal consumption. Each break in these cost curves represents a change in recommended type and equipment. Remember it is possible to use less elaborate equipment in smaller plants with no important sacrifice of handling convenience or operating cost.

Suppose you decide on a tile storage silo for a plant below 15,000 tons per yr and want to know fixed charges. Ignore this break as you come down the curve and continue line back to the left. Fixed charges naturally run higher. But in making up Fig. 4, all unnecessary frills were left out. The aim was a system to give optimum over-all economy and convenience but no extras.

Labor Costs. What, then, did go into the systems of Fig. 4? The intention was to have the boiler operator handle all coal and ash within the boiler room without neglecting his other duties. For instance, the break at the 5000-ton point, Fig. 4, represents the place where push-button control for inside coal handling becomes economical. Automatic ash handling comes into the picture at 9000 tons. In smaller plants you can justify



3 Base thinking for handling equipment on coal consumed, not steam capacity



4 Here are fixed charges on per-ton-of-coal basis. They keep outlay in line

II: TYPICAL INSTALLED COSTS OF HANDLING SYSTEMS

Plant size, tons, yr	Handling equipment for Coal	Ash	Silo capacity, tons	Elevator capacity tons, hr	Erected cost in $ Coal	Ash	Investment per annual ton coal, $
300	Monorail hoist		—	—	800		2.67
2,000	Monorail hoist, bin		—	—	800 to 3700		Under 1.85
5,000	feeder or lift truck		—	—	1000 to 5000		Under 1.00
6,000	Note 1	Hoist	120	25	14,000	1,000	2.50
9,000	Note 2	Pneumatic	180	25	18,000	12,000	3.33
12,000	Note 2	Pneumatic	240	25	20,000	16,000	3.00
15,000	Note 3	Pneumatic	300	25	29,000	16,000	3.00
30,000	Note 4	Pneumatic	600	50	42,000	23,000	2.17

By **CARL A MARSHALL**, *Director*, and **DONALD M GIVEN**, *Fuel Engineer*, *Fairmont Coal Bureau*

To Small-Plant Levels

handling equipment that needs occasional attention, some labor.

Outside-the-plant coal handling involves unloading coal cars (unless you use trucks), as well as moving coal into and out of ground storage. A silo or bunker that holds a one-week supply eliminates the need to pull from ground storage except in emergencies and in that way reduces labor costs for handling reserve coal.

Bartgis Brothers Co, Ilchester, Md., keeps their coal pile a quarter mile from the plant and there it sits except for emergency. They work out of a silo built for 700-ton storage to supply a 30,000-ton annual consumption. Once a year they hire a bulldozer to turn over the pile and compact it (POWER, January 1952, p 82).

Contrast this record with a New Jersey firm of the same boiler-plant size that operates out of an overhead bunker holding only a one-day supply. (Installed cost of this small bunker ran about the same as the 700-ton silo above.) Their ground storage is in constant use and they're battling fire, dust and high extra-labor costs.

Unloading Coal. What does unloading coal from freight cars amount to in dollars and cents? Roughly 6 to 12c per ton using labor at $1.50 per man-hour and allowing from 2 to 4 man-hours for 50-ton car in the small plant burning under 30,000 tons per yr.

Since this means only 12 carloads per week or less, coal unloading constitutes a part-time job for the small plant. If you have to assign one or two full-time men to a boiler room for this job, the costs you charge against coal go way up. Table I shows how such extra labor mounts up on a full-time basis.

Extra man costs should never exceed 24c per ton. This figure allows at least twice the time that could conceivably be used in unloading coal. Many plants today lick this headache by drawing labor from a central pool or a part-time charge for specific job details.

How about frozen coal? You can get around this problem with portable car-thawing units, Fig. 2. They run about $262 each. Or if you handle considerable coal, put in a car-thawing pit with one unit per car hopper for about $1500 per unit. Either type thaws a car out in under an hour's time.

While you're about it, consider the advantages of car shakers. For a small plant $1700 buys a movable device, Fig. 1, complete with hoist or dolly. Heavy-duty car shakers cost $12,000 up, installed. None eliminate the need for car thawing but they all empty a car "broom clean" in less than 15 minutes if the conveyors can handle coal that fast.

In the plant sizes in Fig. 4 the selected conveyors are only 25 to 50 ton-per-hr capacity so the shaker has to be started and stopped several times regardless of its capacity.

Maintenance Costs. Selected equipment in Fig. 4 is as sturdy and reliable as you can get. But all need good preventive maintenance. Actual maintenance costs should average about 10 to 25c per ton. The higher charges occur in the smaller plants because of higher unit costs and not because of any difference in equipment sturdiness. When you use high-maintenance conveyors of the screw or bulk-flow type, overdesign to control maintenance.

Highest totals for all handling costs —fixed at 50c, operating at 24c, and maintenance at 25—come under the $1.00 per ton. Some of the plants in Fig. 4 can do the job for 50c per ton.

Many existing installations could profitably be modified or even replaced where labor and maintenance charges prove excessive. Using large-capacity silos to augment or replace small-capacity bunkers is one step that would pay in many plants. To convince management, all the data you need is a yardstick such as Fig. 3 and 4 provide.

Table II summarizes typical costs for handling equipment, both coal and ash, for various-sized plants. Use it to guide your thinking on whether mechanical coal and ash handling can improve your boiler-plant picture.

Case Histories. Every operating man who gets into this subject wants to be convinced. He asks for case histories, typical installations. They'll appear in next issue of POWER.

Photos: Fig. 1—Courtesy, National Conveyor and Supply Co; Fig. 2—Courtesy, Hauck Mfg Co.

ARRECIFES on the shores of the Caribbean Sea in Venezuela, South America, takes its name from the reefs extending into the ocean at this point. Modern semi-outdoor plant uses highest steam conditions now applied in this growing country

ARRECIFES Helps Venezuela Grow

Steam plant at ocean shore feeds electric energy into growing transmission grid. Modern plant for 50-cycle system can be easily converted to 60-cycle frequency for future need

By **O H PFERSDORFF***, *Project Engineer, J F Pritchard & Co.*
and **AMILCAR SORIANO R**, *Chief Constr Engr, C A La Electricidad de Caracas*

*Mr Pfersdorff is now in Production Dept of Electricidad de Caracas

► THE ARRECIFES POWER STATION of the C A La Electricidad de Caracas, Caracas, Venezuela, stands at the foot of a small valley in the eastern branch of the Andes Mountains on the shore of the Caribbean Sea. The plant name comes from the reefs that extend into the sea at this point. The main Venezuelan seaport, La Guaira, can be reached by eight miles of winding mountain road, while the capital, Caracas, is 35 miles away over the mountains.

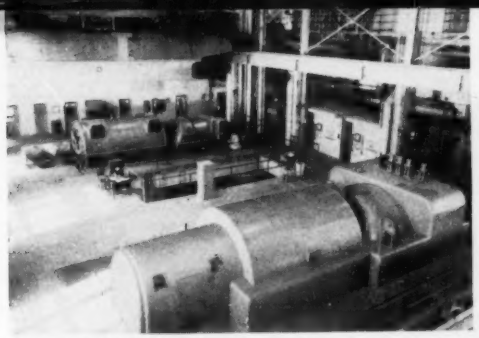
At present Arrecifes has two 20,000-kw turbine-generators and feeds the transmission system serving industrial and residential loads of the Federal District of Venezuela and part of the State of Miranda. It augments the output of a 31,500-kw steam plant at La Guaira, a 10,000-kw diesel plant in Caracas and several small hydro plants in the mountains. A third unit of 30,000-kw capacity will start this year and the fourth, also 30,000 kw, is scheduled for 1954.

Arrangement. The plant uses the unit-system layout without cross connections. Individual panelboards in front of each boiler hold all boiler manual and automatic controls. Turbine and generator panels back onto the boiler panels forming a duplex walk-in layout. Starting and stopping controls for turbines and auxiliaries center in these panels. An air-conditioned main switching and control room, about 20 ft above one end of the turbine room, supervises field adjustment and synchronization.

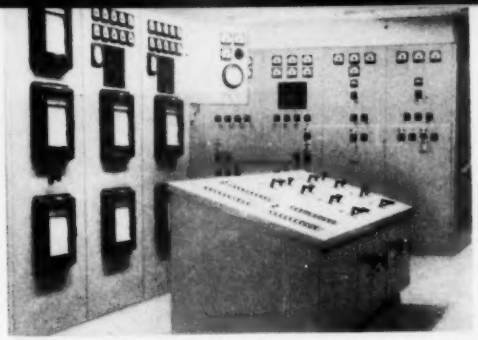
Although the system runs at 50 cycles all Arrecifes equipment is designed for both 50- and 60-cycle operation where possible. Where future change will be necessary, the design minimizes the amount of alteration needed.

The semi-outdoor construction houses the turbine-genera-

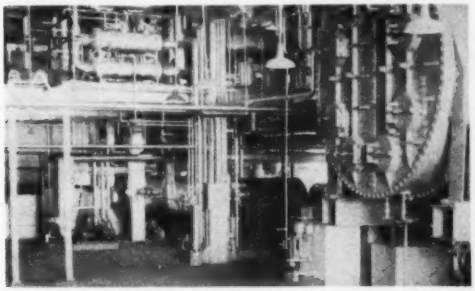
PUMP HOUSE AT SHORE takes circulating water from ocean through concrete intake flume. Circulating pumps, for main condensers, and other pumps stand in pump house rather than in main plant. If needed later, chlorination units may be put in



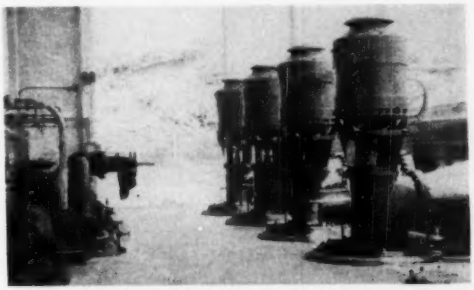
TWO 20,000-KW UNITS comprise initial installation. Boiler fronts stand at the right behind duplex panel control boards



ELECTRICAL CONTROL ROOM stands at upper level overlooking main turbines. Boilers and turbines are controlled from floor



EVAPORATOR, BOILER FEED PUMP stand next to main condenser on basement floor. Heaters rest on the mezzanine above

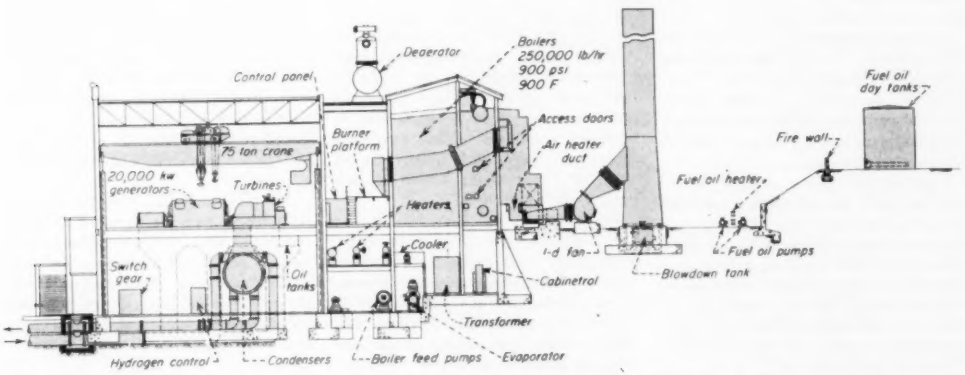


FOUR CIRCULATING PUMPS for first two main condensers stand in pump house with screen-wash and other auxiliary pumps

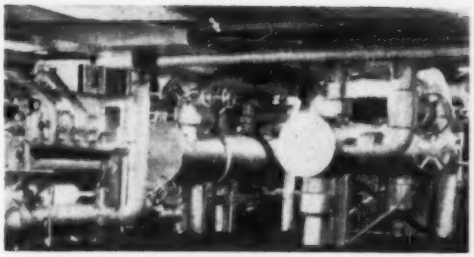
tors, their auxiliaries, four motor-driven feed pumps, air compressors, heaters and bearing-cooling pumps. Equipment outdoors includes boilers, f-d and i-d fans, fuel-oil pumps, oil heaters, deaerating heaters, hot-process water softeners, and filters. Boiler fronts form part of the main building wall. Condenser circulating-water pumps, generator hydrogen cooler and turbine oil coolers stand in the pump house at the ocean's edge. Ocean water comes in through a 200-ft concrete flume to be pumped to the condensers, oil coolers and hydrogen coolers through 10- and 36-in. cast-iron pipes.

Main condensers have divided waterboxes, using double-flow and a down-flow arrangement. The latter has prevented sand accumulating in the waterboxes.

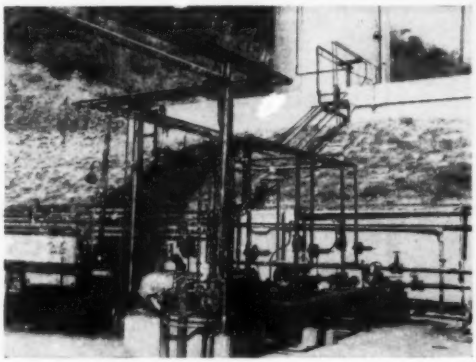
The 900-psig 900-F 250,000-lb-per-hr boilers take feedwater at 340 F. Each boiler has mechanically atomizing burners firing Venezuelan bunker-C oil. Pipelines are now being laid to supply natural gas from eastern Venezuelan fields about 100 miles away. The 350-psig gas supply will throttle to 100-psig before entering the combustion-control valves, which in turn drop pressure to 10 psig at the burners. Gas rings, which will be added to the present burners, will allow dual-fuel firing. (*Continued on page* 90)



UNIT ARRANGEMENT of plant has one boiler feeding each turbine. Each boiler has individual stack. No cross connections are made between units. Straight regenerative cycle uses four bleed points feeding 3 closed heaters, one deaerator



HORIZONTAL FEEDWATER HEATERS on mezzanine level, below operating floor, work with deaerating heaters on roof



FUEL-OIL PUMPS take fuel from day tank in background and pass it to boiler burners at 300 psig and rate of 50 gpm each

DIGGING OUT 12 feet of debris, carried into plant by flood, which buried feed pumps, compressors and evaporators in rear

Two compressors supply instrument and combustion control needs for two units. One plant compressor supplies general needs and augments the instrument compressors through a pressure-regulating valve in emergencies.

Because Venezuela does not manufacture hydrogen now, it is expensive and uncertain to get makeup gas to replace normal leakage. To create such a supply an automatically controlled unit for electrolytic decomposition of water has been ordered. It will produce hydrogen at 35 cfh at a purity greater than 99.5%. This will be enough for future needs. The hydrogen unit will be some distance from the plant but will be under control of the operating crew.

Lighting and power conduit, cables and ductwork are all carried overhead above the basement floor. The only underground wires are in concrete ducts between the main building and outdoor substations. This proved more convenient for installation and needed somewhat less material without detracting from appearance or causing congestion of conduit and pipe.

Water Supply. Space in the pump house will allow future installation of chlorinating equipment if it should be needed. Installation has been deferred because at the La Guaira steam plant a mussel coating 2-in. thick had accumulated each year in the circulating-water system. Since then a cathodic-protection system installed to reduce corrosion has allowed only a 1½-in. thick coating to accumulate in a 2½-year period.

It was decided to see if this system also caused a similar retardation at Arrecifes after a one-year period. Sea-plant growth is apparent only in the intake canal and pump house where the water is exposed to sunlight, but in negligible amounts. The condenser tubes have stayed relatively clean of algae by the scouring action of suspended silica and mica.

Sweet water piped from the Marapa hydro station reservoir, three miles away, serves as bearing coolant. This water discharges to a sump to minimize waste. From here pumps circulate it through heat exchangers, bearings and small coolers back to the sump. Sea water, from the same source supplying the turbine oil coolers, also cools the heat exchangers in the sweet-water system. Filtration and treatment make the sweet water potable.

Sweet water also serves as makeup after filtering and treatment in a hot-process softener primarily to remove silica. Pumps pass treated makeup to evaporators.

Construction. Original building design considered using a floating mat foundation since exploration showed firm bearing for this type of construction. But there was also an average 6-ft-thick stratum of softer, finer material about 25 ft below the ground surface extending into the sea. After thorough deliberation a pile foundation was selected to avoid possibility of squeeze or shift in the softer strata from continuous vibration.

All pipe including the low chrome-moly main steam piping was field fabricated and stress relieved. Many local welders were tested before a sufficient number were found to make up the piping crew. All labor, contractors and subcontractors were local. A total force of five supervisors and clerks were from the U.S.A.

Operation. The first unit started running in Oct 1950 carrying normal peak-

PRINCIPAL POWER-PLANT EQUIPMENT

Arrecifes Plant, Units No. 1 and 2, C A La Electricidad de Caracas, Venezuela

Power-Generating Equipment:

Turbine generator, 1 ..... International General Electric Co
20,000 kw, single flow, 3000/3600 rpm, 19 stages, 4 bleed points, 850 psig, 900 F, hydrogen-cooled generator, 80% pf, 25,000/30,000 kva, 11,500/13,800 v, 50/60 cycles, direct-connected 250-v 105-kw exciter

Turbine-generator, 1 ..... Allis-Chalmers Mfg Co
20,000 kw, single flow, 3000/3600 rpm, 4 bleed points, 850 psig, 900 F, hydrogen-cooled generator, 80% pf, 25,000/30,000 kva, 11,500/13,800 v, 50/60 cycles, direct-connected 250-v 103.5-kw exciter

Main condensers, 2 ..... Allis-Chalmers Mfg Co
22,500 sq ft, horizontal, 2-pass, 1-in. OD, No. 18 Ambraloy tubes, 171,000 lb steam per hr, 25,000-gpm cooling water

Steam-jet air ejectors, 2 ..... Allis-Chalmers Mfg. Co
Twin element, 2 stage

Starting air ejectors, 2 ..... Allis-Chalmers Mfg Co

Circulating-water pumps, 4 ..... Allis-Chalmers Mfg Co
13,000 gpm, vertical, axial flow, 30-ft head, 970/1160 rpm, 150-hp motor drive

Condensate pumps, 4 ..... Allis-Chalmers Mfg Co
400 gpm, 2 stage, 210-ft head, 1450/1760 rpm, 40-hp motor drive

Steam-Generating Equipment:

Boilers, 2 ..... Combustion Engineering-Superheater, Inc
250,000 lb per hr, 900 psig, 900 F, tubular air heater

Boiler setting refractory ..... Refractories Corp

Boiler insulation ..... Refractory & Insulation Corp

Water gages ..... Reliance Gauge Column Co

Safety valves ..... Manning, Maxwell & Moore, Inc

Steam gage ..... Manning, Maxwell & Moore, Inc

Valves ..... Edward Valves, Inc

Oil burners, 12 ..... Peabody Engineering Co
Mechanical, wide range, 250-psig oil pressure

Soot blowers ..... Vulcan Soot Blower Corp

Induced-draft fans, 2 ..... American Blower Corp
127,000 cfm, double inlet

I-d fan fluid coupling, 2 ..... American Blower Corp

I-d fan drive, 2 ..... Allis-Chalmers Mfg Co
Motor, 300 hp, 720/750 rpm

Forced-draft fan, 72,000 cfm, 2 ..... American Blower Corp

F-d fan drive, 2 ..... Allis-Chalmers Mfg Co
Motor, 150 hp, 1500/1800 rpm

Fuel oil heaters ..... Griscom-Russell Co

Emergency electric oil heater ..... General Electric Co

Fuel oil pumps, 50 gpm, 4 ..... H K Porter Co

Feedwater System:

L-p feedwater heater, 2 ..... Griscom-Russell Co
Horizontal, integral subcooling zone, 1265 sq ft, admiralty tubes

I-p feedwater heater, 2 ..... Griscom-Russell Co
Horizontal, 596 sq ft

H-p feedwater heater, 2 ..... Griscom-Russell Co
Horizontal, 648 sq ft

Deaerating feedwater heater, 2 ..... Elliott Co
243,000 lb per hr, 60,700 lb storage

Boiler feed pumps, 4 ..... Allis-Chalmers Mfg Co
7 stage, double suction, 620 gpm, 2610-ft total head, 3600 rpm

Boiler feed pump, 600-hp motor drive, 4 ..... Allis-Chalmers Mfg Co(3); General Electric Co(1)

Evaporator, 12,500 lb per hr, 2 ..... American Locomotive Co

Condensate transfer pumps, 140 gpm, 2 ..... Allis-Chalmers Mfg Co

Evaporator feed pumps, 2 ..... Allis-Chalmers Mfg Co

Heater drain pumps, 60 gpm, 4 ..... Allis-Chalmers Mfg Co

Water-treating equipment ..... Allis-Chalmers Mfg Co
Hot-process softener, 12,000 gph, 100-gpm filters

Auxiliary Equipment:

Bearing cooling-water pumps, 4 ..... Allis-Chalmers Mfg Co
Vertical, submerged, centrifugal, 15-hp motor drives

Salt-water pumps, 4 ..... Allis-Chalmers Mfg Co
Vertical, submerged, centrifugal, 1200 gpm, 90-ft total head, 40/50-hp motor drives

Screen wash pump, 1 ..... Allis-Chalmers Mfg Co
700 gpm, 1990-ft head, 50/60 hp motor drive

Traveling water screens, 52,000 gpm, 2 ..... Chain Belt Co

Plant air compressor, 1 ..... Chicago Pneumatic Tool Co
2 cyl, 2 stage, air cooled, 40-hp motor drive

Instrument air compressors, 2 ..... Chicago Pneumatic Tool Co
2 cyl, 2 stage, air cooled, 15-hp motor drives

Turbine oil filter, 2 ..... Wm W Nugent & Co
360 gph, motor driven

Bearing water cooler ..... Griscom-Russell Co

Turbine-room crane ..... Manning, Maxwell & Moore, Inc
75-ton main hoist, 5-ton auxiliary hoist, 64-ft span

Control-room air conditioners, 2 ..... Chrysler Corp

Ventilating fans, 5 ..... American Blower Co
Two 15,000 cfm, one 46,000 cfm, two 65,000 cfm

Cast-iron pipe ..... Alabama Pipe Co

Steel pipe ..... Moorlane Co

Boiler stop valves ..... Wm Powell Co

Boiler blowdown valves ..... Yarnall-Waring Co

General valves ..... Henry Vogt Machine Co; Wm Powell Co

Steam traps ..... Armstrong Machine Works

Pipe insulation ..... Philip Carey Mfg Co

Tank and duct insulation ..... Baldwin-Hill Co

Regulating and control valves ..... Fisher Governor Co

Pressure gages ..... Manning, Maxwell & Moore, Inc

Thermometers ..... Palmer Thermometers Inc

Temperature recorders ..... Leeds & Northrup Co

Conductivity meters

Vacuum indicator and barometer ..... Meriam Instrument Co

Vacuum recorders ..... Republic Flow Meters Co

Pressure and level switches ..... Mercoid Corp

Temperature-control valve ..... Taylor Instrument Cos

Water-level indicators ..... Yarnall-Waring Co

Displacement meters ..... Buffalo Meter Co

Combustion control
Steam-temperature control
3-element feedwater control ..... Bailey Meter Co
Boiler—turbine panels

Intercommunication system ..... Western Electric Co

Engineers and constructors ..... J F Pritchard & Co

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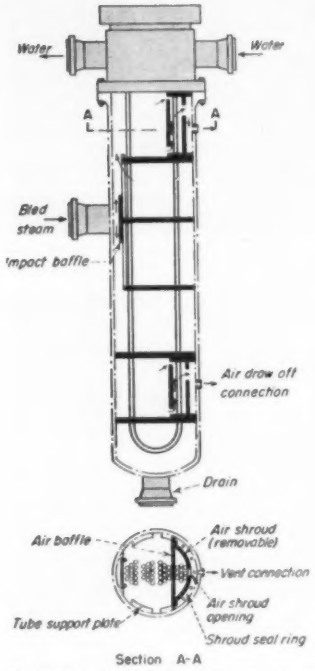
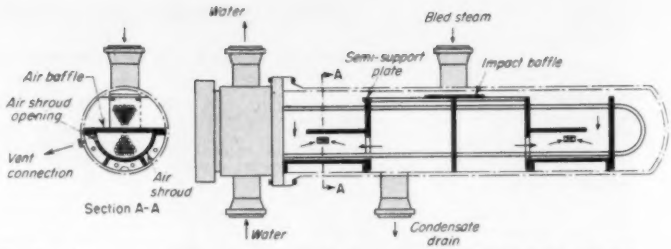
from 15,000 to 18,000 kw. On occasion it carried as much as 28,000 kw. No. 2 was scheduled to start March 1951. Late in February, however, unprecedented rainfall and resulting landslides forming rivers of rock and gravel damaged the outdoor equipment and filled the plant basement with 12 ft of mud and debris. This delayed the starting date of No. 2 till May 22, 1951.

Initial consideration of possible plant damage from floods, because of the location in a valley in rather steep, mountainous terrain, showed comparative safety because of ample drainage area. But after a week of continuous rainfall the rock overburden slipped off the mountain slopes causing a great dam in the river. When this dam burst it spread rock, gravel and debris over the entire valley and inundated the power plant. To prevent a recurrence a 15-ft diversion wall of steel-sheet piling has been driven on the plant side of the gorge extending about 600 ft up the valley from the sea.

Since starting the plant, system load has reached 75,000 kw. The third unit will probably be needed before it is ready for operation to maintain firm system capacity with a one-unit outage.



1 Well-designed heaters lead vented gas past feedwater inlet to remove vapor



2 Closed heaters, operating at subatmospheric pressures and not vented, can and will drop their load within minutes. As air concentration builds up, temperature differential and heat-transfer drop way off. Proper venting is an important aid

Here are sure ways to solve problems in...

Venting Feedwater Heaters

By **F T ELDER**, *Engineer, Alco Products Division, American Locomotive Co*

► THOROUGH, CONTINUOUS REMOVAL of air and noncondensable gas from feedwater-heater vapor spaces becomes more urgent as extraction pressure drops. In fact, closed heaters, operating at subatmospheric pressures and not vented, can and will drop their load within a few minutes.

The cause is twofold: (1) loss of temperature differential, and (2) reduction in average heat-transfer coefficient. Both come from a build-up of non-condensable gas within the heater. Here's how it comes about.

A closed feedwater heater is primarily a condenser even though a condensate subcooler or desuperheater, or both, are made an integral part of it. Incoming steam vapor plus some entrained non-condensable gas enters the condensing space and most of the liquid condenses out. Condensate leaves from a bottom connection, Fig. 1-3, which you will note is always under an effective liquid seal. Unless special exits are provided the noncondensables can move no farther and tend to build up in concentration. In effect, the unvented, closed feedwater heater becomes a dead-end street for noncondensables.

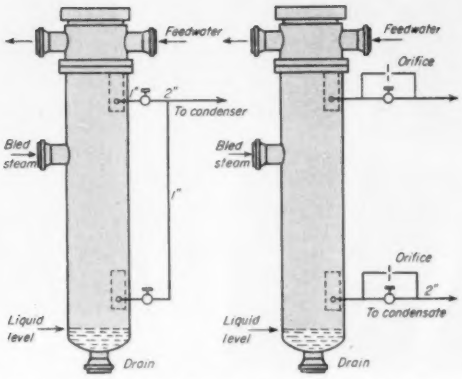
Temperature Differential. In theory the partial pressure on the condensing steam vapor goes down in proportion to the mol percent of noncondensables mixed with it. If you extract steam at 7.0 psia and there's 2% by weight of air caught in it, condensation takes place at 176.2 F only 0.65 deg below saturation temperature. Now if that 2% of weight of air can't get out fast and completely, average air concentration builds up. Suppose it levels off at around 20% in the condensing space.

Partial pressure in the incoming steam vapor drops from 7.0 psia to 6.0. Dew-point at this pressure is 170.1 F, nearly seven degrees below saturation. Much closer to temperature of the boiler feed-water running through the heat-exchanger tubes and acting as the condensing agent. Heat-transfer capacity is bound to drop sharply with such a fall in temperature differential.

Heat-Transfer Coefficient. An even more important factor in feedwater operation is the over-all heat-transfer coefficient. A small amount of non-condensable in the vapor affects it greatly. The condensation process itself has heat carry over from the hot medium to the cold medium by a mass diffusion of droplets of condensed vapor that settle out to form a condensate film on the cold surface. With non-condensable gas present these droplets have to penetrate through the gas layer overlaying the condensate film.

How does an actual case work? With nonferrous tubes carrying water within them at normal commercial-water velocities the heat transfer coefficient for pure steam runs 600 to 1000 Btu per hr per sq ft per deg F. And for concentration of 1 to 2% of noncondensables in the vapor stream, the diffusion coefficient from the vapor stream to the condensate layer is about 10,000 to 20,000 Btu per hr per sq ft per deg F. When you raise noncondensables up to 20%, by weight, the diffusion coefficient drops about ten-fold. Effect on over-all heat transfer becomes very noticeable. You can relate the effect directly to the ratio of partial pressures in the noncondensables and the vapor. As the condensing process continues along the length of the heater and the proportion of noncondensables becomes relatively larger, the instantaneous coefficient falls off.

When both average heat-transfer coefficient and temperature differential fall off, the feedwater heater rejects some of its condensing duty. A part of the



3 To be good, vent piping has to be right. It should be generously sized, as short as possible, direct, free of traps and of loops

load transfers to the next higher-pressure stage heater and so on to unbalance the turbine heat cycle and reduce thermal efficiency.

Improper Venting. How about solving the problem by vent openings? Best approach seems to be that they be large enough and properly connected with the vapor spaces. In fact, there should be enough vent openings to handle even an excess volume of noncondensables.

Vents by themselves aren't the complete answer. Internal heater arrangements need to be planned so they don't upset venting paths. For example, a closed heater may effectively purge one section of noncondensables while permitting a pocket to form for unvented gas in another section. Such a condition renders a large proportion of the heat-transfer surface ineffective, and there's still the added possibility of attack from corrosive agent build-ups in the moisture atmosphere of one of these local noncondensable gas pockets. Two good reasons for improved internal arrangements.

Unfortunately there's no set, rational way of predicting quantity or quality of noncondensable gas that will appear at any given bleed point. Its presence in the system is accidental in the first place. Air infiltrates where cycle pressures drop below atmospheric; gas enters with the makeup feedwater. Amount of infiltrating air depends on tightness of the glands, pump packing, piping. Makeup noncondensables vary with the nature of the raw water, its pretreatment, efficiency of deaeration.

Because of these unknowns the feedwater-heater manufacturer can't design the venting system. What he can do is draw on his experience in providing adequate venting holes and in correct arrangement of heater internals.

On well-designed feedwater heaters the vent openings communicate with "air boxes"—shrouded sections surrounding the feedwater inlet, or coldest, pass. These boxes draw in the vapor, rich in noncondensables, at one side, pass it over the relatively cold tubes to condense out most of the moisture and reject the stripped gas through openings in the shell into a lower-pressure receiver. Condensate drains from the baffled sections through openings in the lower plates and returns to the main condensate streams.

Except for very high-pressure stages one air-withdrawal box should go in at each end of all heaters. With some piping arrangements, notably where extracted steam enters at the extreme end of the heater shell, air-box location and arrangement merit special attention. But this is properly the designer's problem.

Fig. 1 shows a typical installation of air baffling in a vertical U-bend feedwater heater. Note that vapor and air enter at both sides of the baffled section and have to traverse active condensing surface before they leave the shell. Fig. 2 pictures a typical internal venting arrangement for a horizontally installed heater.

These air shrouds should preferably be connected separately and independently to the receiver, and particularly so where steam extraction is at low pressure. Occasionally piping or installation arrangements make it convenient or desirable to interconnect the shrouds internally and withdraw the gas from the shell through a single opening. Such a case would be a low-pressure heater, installed within a condenser neck and with one end projecting outside the plate but enclosed in a sleeve. But this arrangement is not ideal and should be avoided where possible.

Use as short and direct a piping hookup as possible for venting a low-pressure heater to a suitable receiver (often the main condenser). Hold bends and elbows down to a minimum and avoid any loops or traps where condensate can collect. Further, use adequate-size lines without restriction or reduction, and cover them with suitable insulation.

Fig. 3, left, shows a vertical heater operating at or below atmospheric pressure. Its vent lines come together into a common line of similar pipe size for connection to the main condenser. This is a poor arrangement. With both vent valves open, little or no venting takes place for the bottom section. There'll always be a small pressure gradient within the heater between steam entrance and tube ends. This, coupled with friction loss in additional pipes and bends from the lower section, results in a larger proportion of venting from the top section. In addition, the small discharge line hasn't enough capacity to carry the volumes that could be withdrawn simultaneously from both sections.

A closer look at Fig. 3 reveals a tendency for a greater portion of the vapor to flow in a downward direction in the heater so more air accumulates in the bottom of the shell. Closing or restricting the top valve to bring about greater venting from the bottom reduces the over-all venting capacity and results in incomplete purging of the upper section.

Fig. 3, right, shows a similar low-pressure heater but with a satisfactory vent piping. Lines are more generously sized and connect directly to the receiver.

Vertical distance between point of withdrawal of vented gases and discharge to the receiver should be held to a minimum. The most it can be is something less than the equivalent of the available pressure differential in feet of water column. Otherwise, any condensate that may accumulate at the withdrawal point could be siphoned into the vent line and block it off.

Any vent piping system needs suitable regulating valves to permit optimum gas withdrawal. Only by experiment can you establish just what is optimum withdrawal. By definition it's the smallest opening that has no appreciable effect on temperature rise in the feedwater stream. Excessive venting wastes high-grade uncondensed steam.

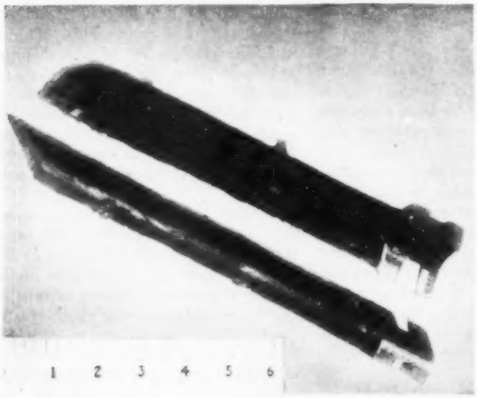
Some operators install an orifice in a bypass around the regulating valve in each vent line so there can be no com-

(*Continued on page* 208)

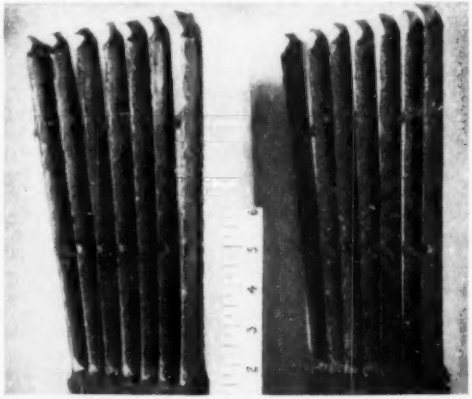
1 Severe, uniform corrosion ate away the blade edges, lashing stays secure

2 Corrosion reduced blade section at lashing, caused pitting behind wire

3 Blade edges notched by corrosion can be ground, polished for more service



6 Older turbines may sometimes have blades with corroded edges like these. Silver solder was used to rebuild edges



7 Chrome-alloy blades, *left*, and 5% nickel blades, *right*, served in some blade row to determine corrosion resistance

Avoid Blade Corrosion and Erosion

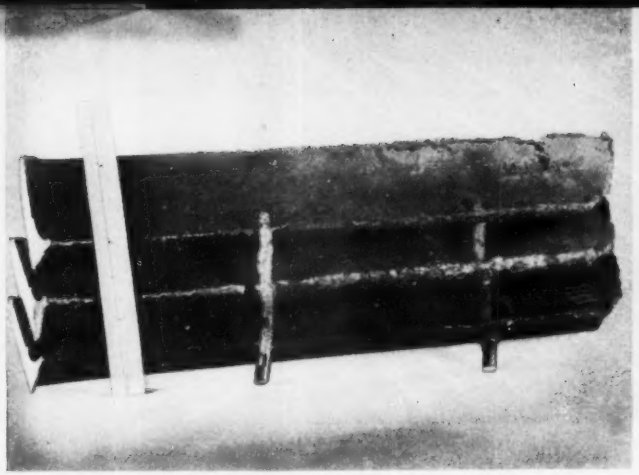
By W H LLOYD, *Blading Engineer, Steam Div, Westinghouse Electric Corp.*

Watch steam turbine blades closely when you suspect a change in steam impurities. Although modern metals usually lick corrosion, you may have to install special materials for a tough problem

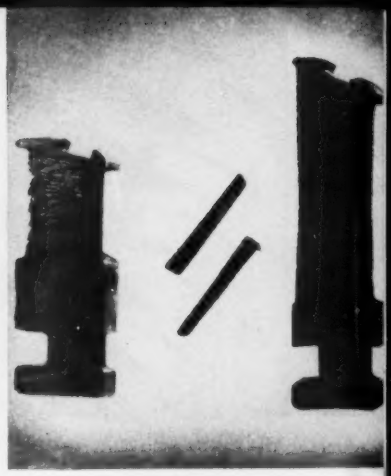
► A VARIETY OF blading materials have been used in developing the steam turbine. Some are resistant to corrosion, like bronze, manganese copper and pure nickel. Others are quite severely attacked, like the steel groups that include 5% electric-furnace nickel, carbon steel and copper-clad steels.

Under favorable conditions, turbine blading lasts for years. Even under unusual conditions, it gives long periods of service. But blading failures as a single cause of turbine outage always create serious operating problems. In an effort to obtain a material that was not subject to corrosion and had higher physical strength, the 12% chrome-iron alloy was developed. Corrosion resistant and possessing excellent physical characteristics, this material is now accepted quite generally throughout the industry.

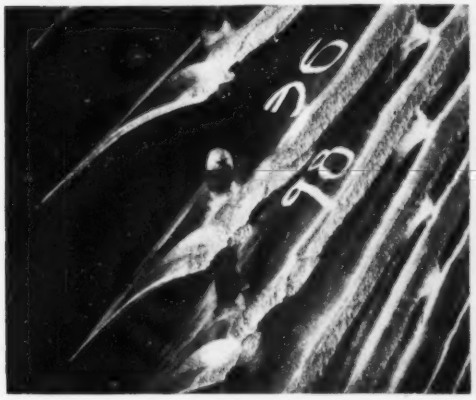
In corroding, a material deteriorates chemically, while in eroding some mechanical process wears away the metal.



4 Over-all corrosion affects blades and lashings uniformly. Attack varies with blade shape, speed, material, standby-period length and quality of the steam



5 Severely corroded blading sometimes continues on duty without any failing



8 Last row blading of chrome alloy can be eroded severely on the inlet edges by wet steam containing 12% moisture

9 Wet-steam erosion concentrated just ahead of lashing wire and then tapered off to zero in about one-half blade length

Corrosion. Turbine-blading corrosion varies considerably. It has more serious effect on spindle blading than on stationary blading. Severity, location, and local concentration differ widely and must be considered for the particular case involved. Fig. 1 shows a typical example of uniformly heavy corrosion. Although attacked quite severely, especially at the tip end, the lashing wire remains secure and there are no localized areas undermined at these stress points. This condition presents a question of efficiency rather than safety of operation.

Fig. 2 shows a contrasting condition where corrosion materially reduced the cross section of the blade at the lashing and concentrated in a deeply pitted local area behind the wire. Despite the more or less uniform over-all corrosion, loss of bond at the wire will inject an element of risk that cannot be overlooked.

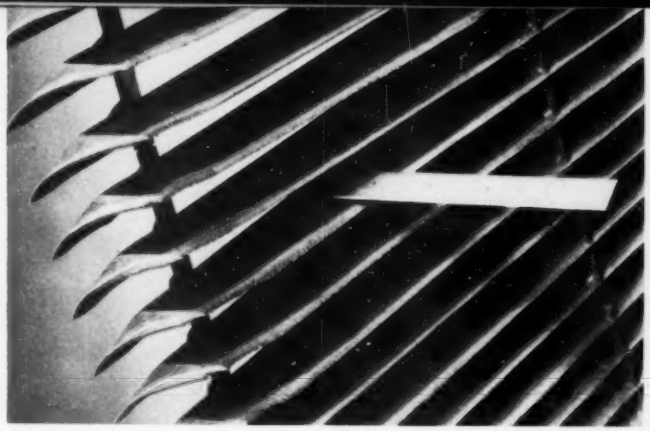
Occasionally edges become notched as in Fig. 3. Here, corrosion on the surfaces is not unduly heavy, but the localized attack if allowed to progress, would eventually reduce the cross section to the danger point. Corroded areas like this can be ground and polished to remove the irregular contour and restore a well-rounded edge, removing the immediate danger. Experience, together with a knowledge of the overall stress picture as related to the blades, determines the extent of grinding.

Group of blades in Fig. 4 is typical of over-all corrosion sometimes found and shows clearly the areas attacked most heavily. Comparing Fig. 1 to 4 shows that pattern, location and severity of attack varies as previously mentioned with blade shape, speeds, materials, standby periods and quality of steam. Each case needs individual handling.

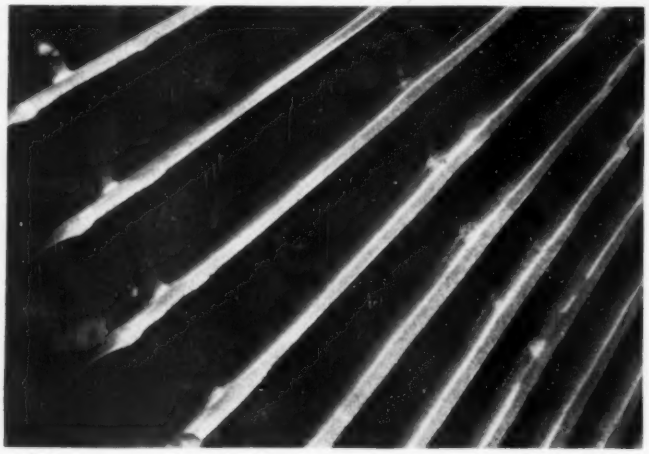
At times corroded blades have been found in service with such reduced cross section it was almost unbelievable that they had not failed. Fig. 5 shows an example of impulse blading, severely corroded, that had not failed.

Loss of material along inlet edge of blading in older designs usually presented a problem with regard to lashing wires. In many instances, the lashing at or near the inlet edge demanded careful and experienced inspection. Restoring this edge to some degree was attempted by depositing silver solder along the edge, Fig. 6. This protected the edge somewhat, but the extent to which it served its purpose largely depended on the bond obtained. This was usually rather questionable, considering the corroded areas soldered.

Fig. 7 compares corrosion attack on

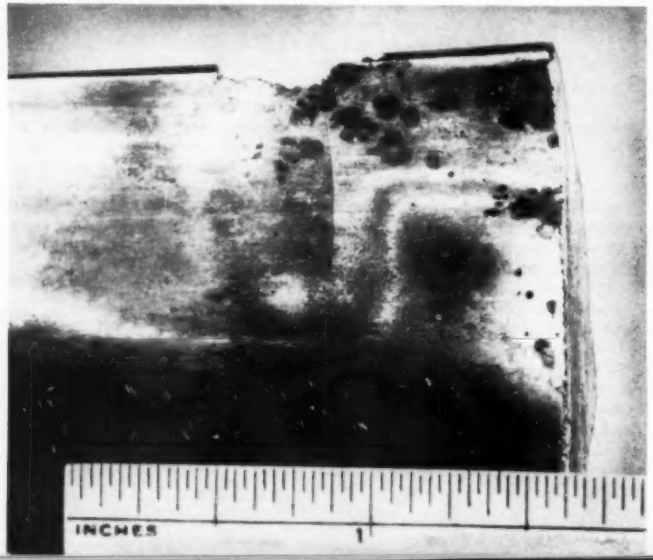


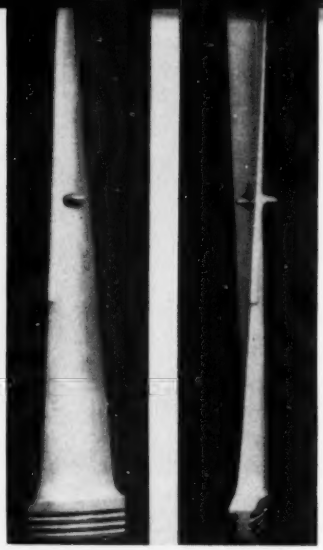
10 Not all blades in one group erode uniformly along inlet edge. Misalignment of inlet edges results in projecting edges being more subject to wearing action



11 Long low-pressure blades are difficult to keep perfectly aligned along the inlet edges. This causes various degrees of erosion on the length of one blade

12 Infrequently, notches on blade edges formed by erosion may start a fatigue failure. This possibility makes it imperative to inspect eroded blades carefully





13 Constant circulation blading eliminates cross flow, reduces erosion

BLADING TROUBLES

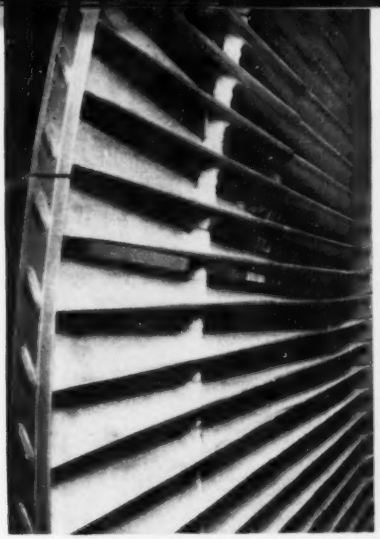
continued

5% nickel with chrome alloy. Both blade groups were part of an experimental row installed for comparison. Appearance of the surfaces is self-explanatory.

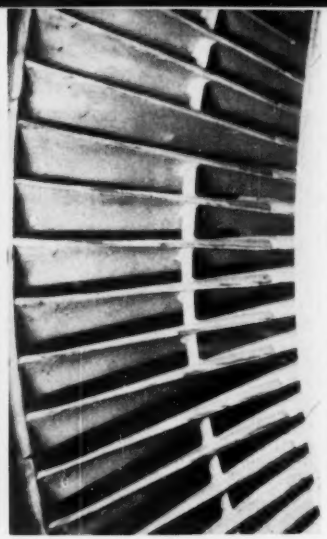
Any decision to replace corroded blading involves either (1) efficiency as the sole consideration or (2) safety of the unit, if it is endangered by the attack. During development of the art, blade replacements in older machines were made with chrome-alloy blading in various locations. Frequently conditions exist where one or more heavily corroded rows are in service followed by rows of new and more modern materials. Consideration must be given in such an analysis to the ultimate result if failure occurs in the doubtful areas and extensively damages the new blades in the following rows.

Erosion. While corrosion attacks certain materials quite severely, the problem of erosion is quite different because it may be present to some degree on all materials. This depends on such factors as individual blade design, design requirement dictating the steam path, location of blade path, quality of steam and speeds. Erosion is rarely, if ever, found ahead of the dewpoint region. But starting there and including the last low-pressure row it can present a serious problem.

Although the chrome-iron alloy in general use is corrosion resistant, it does erode rather heavily along the inlet edge, Fig. 8. This blading is the last low-



14 Constant circulation blade row has stellite shields on near inlet edges



15 Only slight erosion shows on outer end of shielded inlet edges of blades

16 Unshielded edges have only been eroded slightly, note scale absence

pressure row of a straight condensing turbine having about 12% moisture content in the exhaust. Fig. 9 shows the extent to which erosion has taken place and its relation to the blade, usually heaviest near the tip and tapering off to zero in about one-half blade length.

Fig. 10 shows the variation in location and severity of erosion of various blades in a group. Not all blades erode in a uniform pattern, nor an equal amount along the edge. This is caused in large measure by misalignment of the inlet edges where certain blades stand "proud" as related to others. Long low-pressure blades present quite a problem in this respect and every effort is made to keep the edges in line to prevent excessive erosion on individual blades, as Fig. 11 illustrates quite well.

In straight-condensing units the last two or three low-pressure rows bear the brunt of the erosion, while in the reheat machine the reduced moisture lessens the erosion. Increased moisture content accelerates erosive action, especially if solids are present in the steam. Eventually moisture becomes so important that some form of protective shield must be installed.

Blade erosion is not usually dangerous if the attack is uniform, even though rather heavy. Unless erosion concentrates at highly stressed areas with reduced local cross section of the blade, it need not cause alarm. In the past it was customary to dress these roughened edges to as smooth a contour as reasonable before further operation. This practice has been virtually abandoned in recent years. Only when protective shields are to be applied, after service, is the edge ground smooth to receive the shield.

Sometimes local notched areas along the inlet edge of rotating blades showed definite evidence of having been caused by the location and shape of lashing wires in preceding rows. These wires formed a definite pattern of flow and contained concentration that occasionally became quite serious. A study of these flow patterns led to using a shape of lashing known as streamlined. This largely eliminated the undesirable effects.

Sometimes the forming of deeply notched areas has started fatigue failure as shown in Fig. 12. This is not generally true.

Development of blade contours has reduced erosion as demonstrated by constant circulation blading, Fig. 13. The constantly changing inlet and outlet angles fulfill ideal flow requirements eliminating radial components of flow and consequently reducing rate of erosion.

Fig. 14 shows the blade contour, shape and type of lashing, and riveted shroud attachment common to the constant-circulation blading used in modern low-pressure elements. Fig. 15 and 16 show typical examples of erosive attack after continued service. Although blade surfaces in Fig. 15 are coated with "carry-over," the erosion attack along the inlet edge is relatively light across the tip of the stellite protective shield. In Fig. 16 the effect is light even though no shield was used. Note the scale-free surfaces of modern chrome alloy compared to the non-resistant types shown previously.

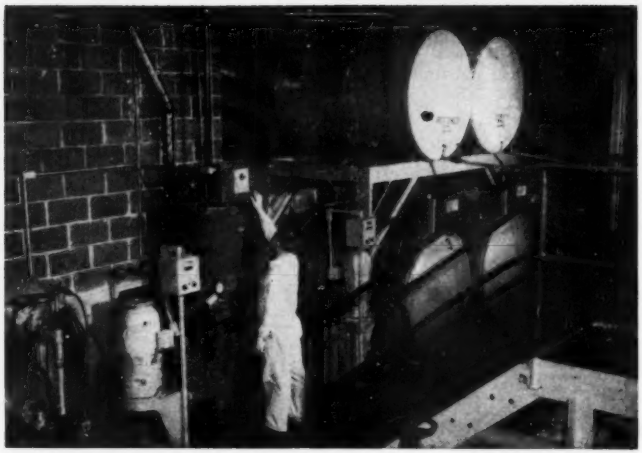
Protective Shields. In an effort to retard erosion, various materials have been deposited along the inlet edge, while others have been attached in the form of a shield. Of the experimental materials, stellite has given the most satisfactory results. Having a high percentage of cobalt and chromium, and with Rockwell hardness of 42 (C-scale), stellite is suitable for both application and erosion resistance.

At times stellite shields have to be replaced. When possible the shield is formed into a curved section or "nose" that fits around the radiused inlet edge of the blade and extends back over the convex surface about $\frac{3}{8}$ in. Severity of expected erosion governs the thickness of shield selected. In general, the last three rows of low-pressure spindle blading are shielded. This may vary, however, with tip speed and percentage of moisture in the steam.

Erosion quite often causes concern that is not justified, at least for safe operation. Life of eroded blading depends principally on its strength, and not on loss of turbine efficiency from surface roughness or change in inlet-edge contour. Rarely, if ever, is a row of blading replaced solely because of eroded inlet edges. The extent to which unshielded blades should be allowed to erode before applying protective shields is a matter of experience and best determined by a turbine inspector. After heavy erosion an experienced mechanic can replace protective shields in the

(*Continued on page* 206)

Complete purification of used oils can often be handled at a fraction of new oil cost. Whether a re-refining plan can be adopted profitably in your plant is simply a matter of economics. Several utility companies have found . . .



AUTOMATIC RE-REFINER, being adjusted by this operator, is installed in Swan Falls Station, Fryeburg, Me. Unit handles 55 gal of dirty diesel lube oil in one batch

...Re-Refined Lube Oil Paid Off in

By R A LUNDBERG
Youngstown-Miller Div, Walter Kidde & Co Inc

► NEARLY THREE DECADES AGO when re-refining of oil was first tried commercially, industry rejected it. The premise then was once lubricating oil had been in service, it "broke down" and could not be reclaimed. With present-day methods this theory has been disproved. Modern re-refining equipment, much of it automatic, can restore new oil properties to dirty lubricating oil. Today's estimate is that, of the more than 500 million gallons of reclaimable oil used annually by all industry, only 4% is re-processed.

Typical Installations. Experience of three public utility plants in New England demonstrates some advantages and savings possible with lube-oil re-refining equipment. They are:

1. Municipal Electric Department, Wolfeboro, N. H.
2. Green Mountain Power Corporation, Station 19, Essex Junction, Vt.
3. Public Service of New Hampshire, Swan Falls Station, Fryeburg, Me.

Generating capacity of the three plants is 2050 kw, 9000 kw and 2800 kw, respectively.

At the Municipal Electric Department, Wolfeboro, N. H., there are five Fairbanks-Morse generators rated at 555, 240, 300, 150 and 784 kw, as lined up in the station.

Capacity of Green Mountain Power Corporation's Station 19 is 4000 kw, supplied by four G-M 1000-kw diesels. Hydroelectric power supplies an additional 5000 kw. The diesels run at peak-load periods.

Two Fairbanks-Morse 1000-kw opposed-piston diesels, at the Swan Falls Station of Public Service of New Hampshire, drive two 400-kw hydroelectric generators. The diesel engines are used mainly for peaking.

Each of these plants has installed a semi-automatic refiner. They re-refine either diesel lube oil, hydro-generator bearing oil, transformer oil, or all three. Contamination found in the diesel oil is dissolved sludge, fuel, water and acid; in transformer oil it's acid, dissolved sludge and other products of oxidation; and in hydro bearing oil, some products of oxidation, dirt and water.

Economics. The oil-change policies used in these stations are similar. Every day or two about one-third of the lube oil from each diesel unit is withdrawn and replaced with re-refined oil. There are savings both in dollars and in increased operating efficiency. For instance, the Swan Falls Station reports cost of new oil at 64¢ a gallon compared with *material* costs of refining at 7¢ per gallon.

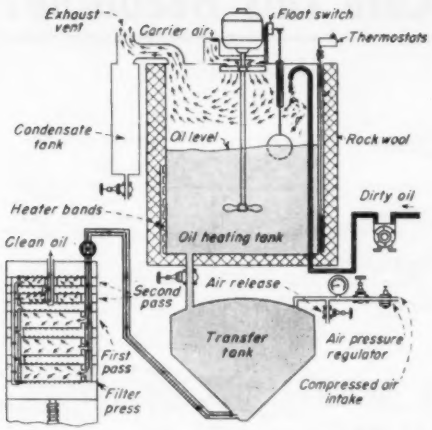
In three of this company's engines—two at Swan Falls and a third at another station—operating statistics show that engine No. 1, operating without a re-refiner, produced 1792 kwhr per gallon of lube oil. However, engines No. 2 and 3, using a re-refiner, developed 2310 kwhr and 2474 kwhr per gallon of lube oil, respectively. This adds up to a saving of almost $200 a year for one engine.

This $200 represents the savings in fuel and lube oil consumed by one engine. We have found fuel consumption decreases somewhat if lube oil is clean and free from sludge, products of oxidation, etc. Further, we also note reduction in actual oil consumed. Besides, there is an additional saving since the same oil is continually reused.

Green Mountain's Station 19 has an even lower material cost per gallon of lube oil re-refined. Its cost per gallon is 1¢ compared with new diesel lube-oil charges of 65¢ per gallon.

Labor costs of re-refining have not been included in these figures. Labor cost is almost negligible as operation of re-refiners is handled by generator-room operators as part of their regular duties. The exception is at low-water periods. Then engines run about 17 hours a day calling for extra labor.

Re-refining Practice. First step is to mix a good grade of



COMPRESSED AIR transfers oil from tank to filter press. Any additives that are removed in process can easily be replaced

Diesel Plants

contact earth—preferably a chemically activated Bentonite clay—with the used oil. Amount of earth can be varied to meet conditions of the oil being treated. It may be as much as one pound of earth or as little as one-eighth pound to a gallon of oil.

After oil is mixed with the clay, temperature is raised electrically. This drives off water, nonlubricating volatiles and fuel dilution. Heat also makes adsorbent earth more active. Since this earth has an affinity for sludge each particle of earth in the re-refiner in time becomes coated with sludge.

While oil and adsorbent clay are being heated and agitated, a fan blows air continually across the oil's surface. This helps volatiles to escape, preventing condensation and re-entry.

Slow, controlled heating removes fuel dilutions, water and low boiling impurities. Presence of earth and elevated temperatures lowers neutralization number to about new oil value. Used oil is restored to its original viscosity, fire and flash points.

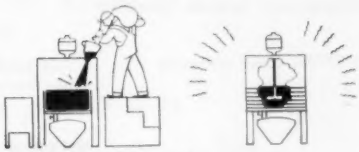
Filtration. The last step is filtration. Here all solids, such as dirt, metal particles, solid sludge and, of course, the contact earth, are removed. A 2-stage plate and frame filter insures removal of even the finest particles.

Additives may be removed by the re-refining process. However, you can buy additives separately and then add them to the re-refined oil in any proportion required. Even if additives are required, the re-refining cost will not be raised by more than one or two cents per gallon—a total re-refining material cost of perhaps 8¢ per gallon.

Oil conditioning can run anywhere from simple settling to mechanical blocking of dirt particles, adsorption, centrifugal action or vaporization. Re-refining equipment available today is actually a combination of some of these separate oil-conditioning elements.

STEP-BY-STEP OPERATION IN THE BATCH RE-REFINING OF USED OIL

DIRTY OIL is pumped to heating chamber. Float control stops pump when correct level reached



ADSORBENT CLAY is added. Heaters raise temperature while agitator mixes the oil and clay

SIGNAL LIGHTS call operator to drop contents of heating chamber by gravity to transfer tank

COMPRESSED AIR forces mixture of oil and clay into 2-stage filter, which removes the solids

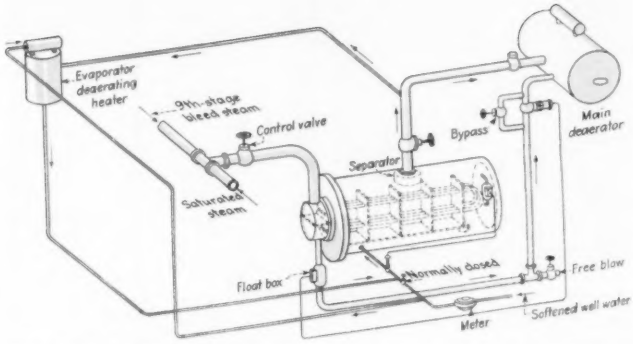
FILTER PRESS frames are lifted out and emptied of dirt and spent clay. Clean oil to storage

Could You Cure This Headache?

▶Have you ever noticed how often elaborate theories seem to get in the way of recognizing simple facts?

▶Here's a case where it took time and effort to find a ridiculously simple answer

By D C SWIFT, *Ebasco Services Inc*



THIS SIMPLE SCHEMATIC SKETCH indicates the principal parts of an evaporator system without showing all the details or complete steam-tube bundle in the shell

Case No. 8— THE LAZY EVAPORATOR

▶ THIS EVAPORATOR in a new Southern power plant was just plain lazy—it wouldn't produce its rated output of vapor—20,000 lb per hr. For a while the only reason seemed to be that the unit was "taking it easy" because of the climate.

The dimetric sketch shows the principal parts of the system, without giving all the details. Deepwells supplied the makeup through a softening system and water meter. Normally the makeup passed through a small deaerating heater, from which it flowed by gravity to the evaporator through a pilot valve. A float box regulated the air-operated pilot valve to maintain desired water level in the shell. Water level was usually held at about one or two inches above the steam-tube bundle.

Normally the 9th-stage bleed point supplied the steam. During low loads saturated steam could be taken direct from the boiler at reduced pressure. A manually operated valve controlled steam flow into the tube bundle. The U-tubes were rolled into the removable tube sheet. Four support sheets riding on an undercarriage supported the tubes along their length. Holes in the support sheets were just large enough to accommodate the tubes.

Header box was divided horizontally by a baffle so steam entered the top tubes and, after flowing through, discharged into the lower half of the box. Steam condensed as it passed through the tubes. The condensate droplets were carried along by the steam or drained into lower half of the header box. From here, condensate drained into a float box or level pot, which controlled the remotely located valve at the main deaerator. Placing the valve here avoided pipe erosion troubles from flashing some of the condensate to deaerator pressure.

Evaporator vapor output flowed through an internal separator into the outlet line and then through a check valve into the main deaerator. Here the vapor heated main feedwater in conjunction with bleed steam from the 13th turbine stage. Vapor output rate depended on steam flow admitted through the hand-operated control valve. In effect, opening the valve raised the evaporator-tube pressure and hence its temperature, increasing the rate of evaporation. Closing down on the valve dropped pressure, temperature and evaporation rate.

Trouble. With the valve wide open, we found the evaporator produced only half its rated output. We checked all the usual causes of low capacity: Relative levels of shell water and top of steam tubes were found OK, gage glasses showed correct levels, pressure gages registered correct values, steam was flowing to the tubes, duplicate water meters gave the same readings, blowdown was normal at about 10% of water feed.

Vents on top of shell and steam-header inlet were open continuously to avoid air binding. Coil drain valve was holding normal water level in the drain float box, well below the lowest steam tube. When we opened the bypass valve around the remotely-controlled valve next the deaerator, water level dropped out of sight in the float box, but vapor output rose about 20%. This seemed to indicate something was the matter with the steam tubes or their drainage.

Evaporator steam tubes were "cracked" several times by spraying cold water on the hot coils. No improvement. The steam-condensate header was removed to check dividing gasket and baffle. There was slight evidence of steam leaking past the gasket, but a new one installed showed no improvement in vapor output.

We took out the tube bundle several times, but always found the interior and exterior of the tubes clean. The outsides were covered by a thin layer of hard material which couldn't have much effect on heat transfer.

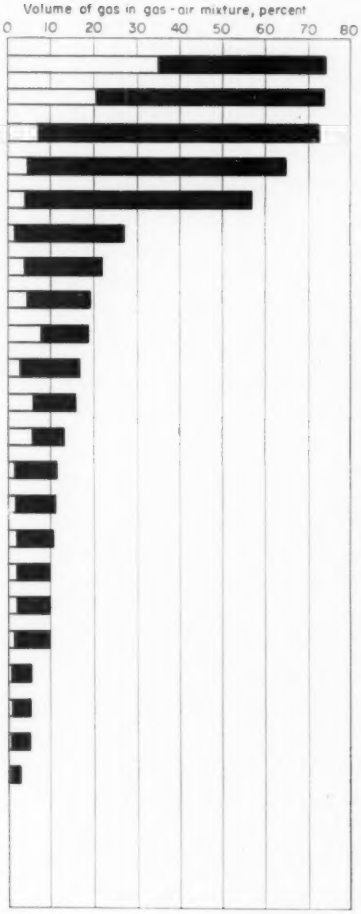
Clues. The manufacturer checked his designs and specifications and found the unit should easily do 20,000 lb per hr with steam and water temperatures prevailing. We used saturated steam instead of bleed—again no difference. We

(*Continued on page* 208)

Power's DATA SHEET

No. 238

Gas	Explosion limits Lower	Upper
Blast-furnace gas	35.0	74.0
Producer gas	20.7	73.7
Formaldehyde	7.0	73.0
Illuminating gas	5.3	65.0
Acetaldehyde	4.0	57.0
Vinyl ether	1.7	27.0
Vinyl chloride	4.0	22.0
Sewage tank gas	5.3	19.3
Methyl chloride	8.2	18.7
Acrylonitrile	3.0	17.0
Ethylene dichloride	6.2	15.9
Oil gas	6.0	13.5
Butadiene	2.0	11.5
Ethyl acetate	2.2	11.4
Propylene	2.4	11.1
Cyclopropane	2.4	10.4
Acetic anhydride	2.7	10.1
Butyl chloride	1.9	10.1
Naphtha safety solvent	1.2	6.0
Petroleum spirits	1.4	5.9
Naphthalene	0.9	5.9
Octane	0.8	3.2
Acetic acid, glacial	4.0	—
Ethylene glycol	3.2	—
Amyl acetate	1.1	—



Explosive Limits in Air

► HERE'S ADDITIONAL DATA on flammability limits of gases. Data sheet No. 181, Sept 1947, gave limits for the commoner gas fuels and some common chemical gases. This chart gives data on gases not included in the earlier one.

Self-propagation of flame takes place within two well-defined limits. These are upper and lower limits given as a percentage of volume of gas present in mixture of gas and air. Within these limits the mixture liberates enough energy to continue burning from one layer to the next. Mixtures above the upper limit may burn on contact with additional external air.

Certain conditions cause a shift in the limits, either increasing or decreasing the spread between them. These conditions include: ignition source, direction of flame travel, containing-vessel dimensions, humidity, oxygen content, pressure, temperature and turbulence.

Reference for gases in this chart is taken from *Handbook of Dangerous Materials*, by N I Sax.

—By J D Constance

Let it rain - Let it pour - High Moisture

This is typical of the experiences of RILEY "50" pulverizer users

"The mills and feeders are performing in a very satisfactory manner. We had a twenty-four hour rain and the coal was so wet, water ran back on the belts to the bunkers. We had considerable trouble with some of our mills, the Riley's didn't seem to notice there was anything different about the coal. The test you ran here may not have been conclusive but after what we went through I believe you can quit thinking about moisture. It seems to have no effect upon your equipment."

An unsolicited letter from a large Midwest Public Utility

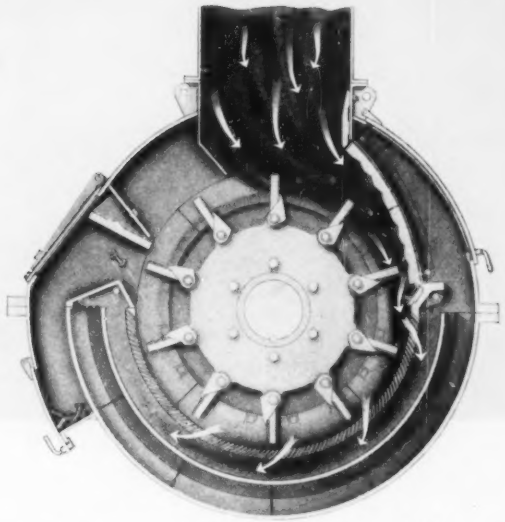
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston Cincinnati New York Charlotte Philadelphia Atlanta Denver Washington New Orleans Salt Lake City Buffalo St. Louis Los Angeles Pittsburgh Kansas City Portland Cleveland St. Paul Seattle Detroit Tulsa Chicago Houston

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

makes no difference to RILEY "50" Pulverizers



Crusher-Dryer Section

The crusher-dryer section, the first stage of the new Riley "50" pulverizer evaporates all free moisture in the coal if adequate primary air temperatures are provided so that moisture has no effect upon capacity or power consumption.

The crusher-dryer section not only dries the coal but it also rejects all foreign materials and crushes the coal to a fine granular state—at least 40% will pass a 50-mesh screen. This section also climinates possibility of damage to the pulverizer by foreign materials as no material larger than ¼" can enter the final pulverizing stage.

Parts faced with tungsten carbides

To minimize maintenance and to assure long periods of continuous operation with sustained fineness, pulverizing elements are faced with tungsten carbide. A six-ton per hour Riley pulverizer equipped with tungsten carbide parts in September 1948 has pulverized over 80,000 tons of coal with no falling off of fineness and with but slight wear of tungsten carbide facing. See illustration of new and used parts at right. The use of tungsten carbide has greatly reduced maintenance material costs and tremendously reduced maintenance labor costs.

Riley "50" Pulverizers give you all these other significant advantages . . . .

Quiet vibrationless operation	Ease of regulation	Ease of ignition
Explosion proof	Small space required	Low lubrication cost
Flexibility—wide load range	Minimum foundation cost	No worms or gears—Just two bearings
Ability to carry extremely low loads	Parts easily renewed	High primary air temperatures
Low power consumption	Can be operated without coal feed	

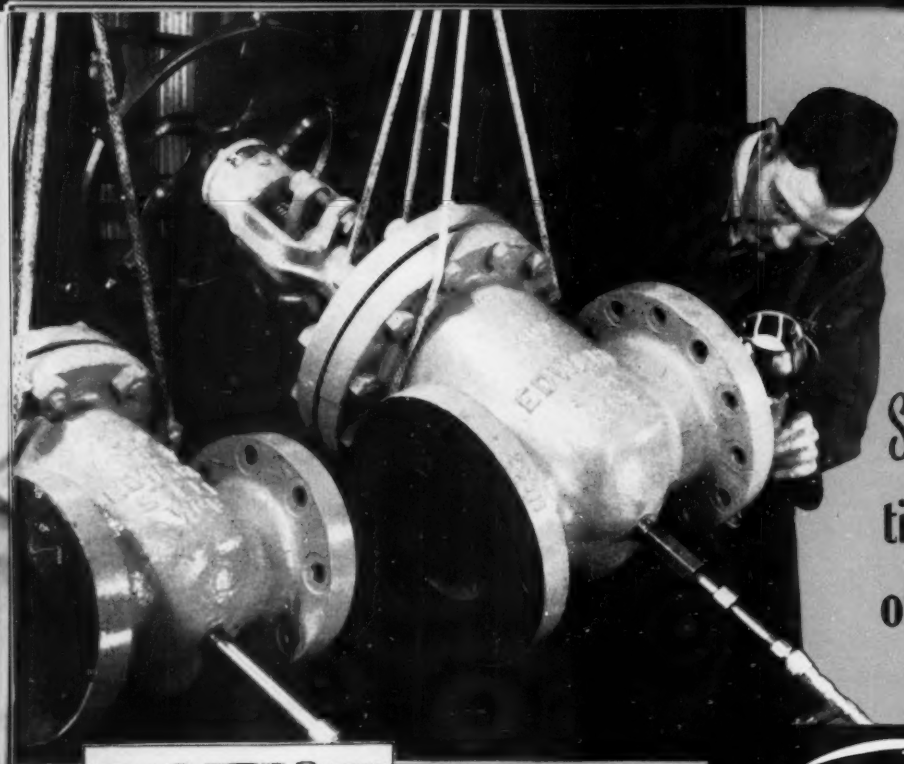
The Riley "50" pulverizer is the latest development in the coal pulverizing field. It will pay you to thoroughly investigate this significant pulverizer development when considering additional coal pulverizing equipment.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

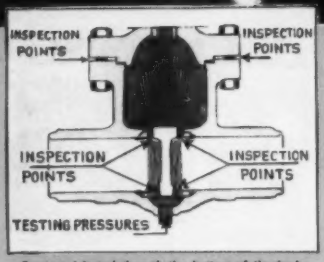
. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

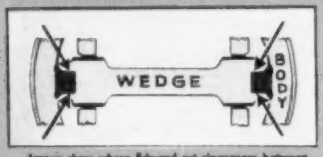


EXCLUSIVE TEST METHOD PROVES *Simultaneous* tight seating of both faces of

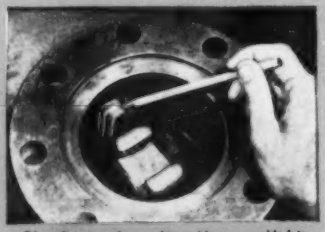
Edward GATE VALVES



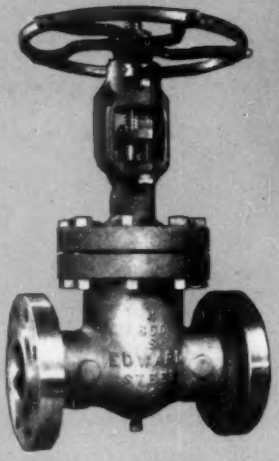
Pressure injected through the bottom of the body surrounds seats, yet leaves both ends open for simultaneous inspection in Edward testing method.



Arrows show where Edward cut clearances between wedge and guide ribs to eliminate wedge drag on seats. With Edward gate valve, partial turn of hand-wheel transfers load from seats to wedge guides.



Edward gate valve wedge guides are welded to body after seats are in place; therefore moving parts are accurately located. Seat rings are also welded in to prevent leakage between seats and body.



When Edward engineers began the design of a new series of steel gate valves, they tested other makes. Many of them were tight on one seating face or the other, but few were tight on both faces.

To build really tight gate valves, Edward engineers discarded the conventional method of casting guide ribs as part of the body and instead developed a new technique for welding the ribs into the body *after the machined seating faces were in place.* This, they demonstrated, reduced machining tolerances, eliminated wedge drag on the seating faces, and cut wear. They were also sure it meant a tighter valve.

But how to prove it? The result was the testing method shown above. Now, *all* Edward gate valves are tested with both ends open for simultaneous inspection, and both seating faces must be tight simultaneously.

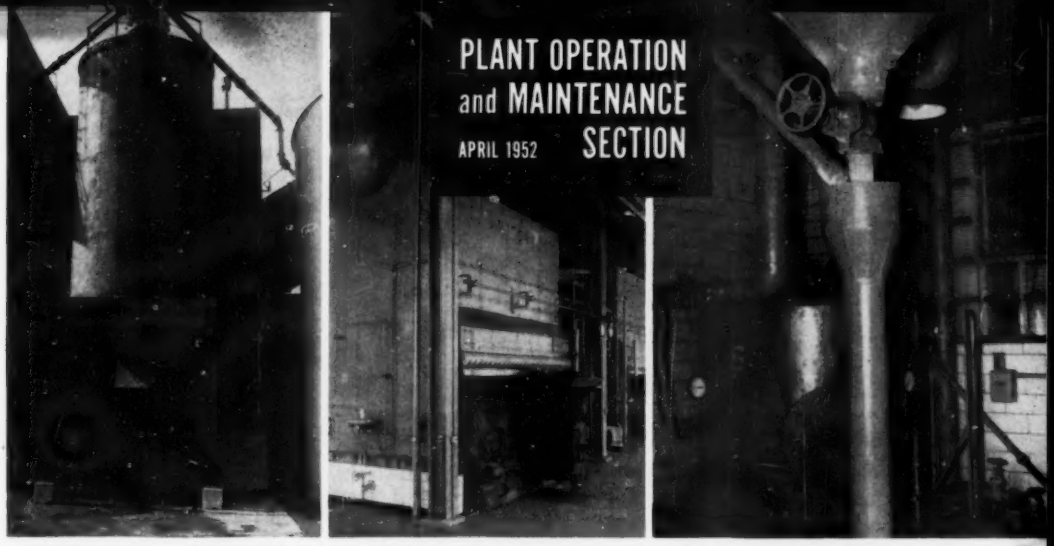
The new Edward gate valves incorporate many other plus-value features, such as welded-in seats, one-piece bonnets, ball bearing yoke bushings in most sizes, and Stellite faced seating surfaces. With Edward, these features are standard construction.

For more details write for Catalog 12-E.

1220 West 144th Street

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO EAST CHICAGO, INDIANA

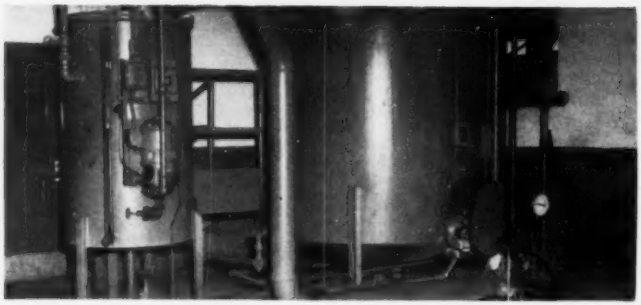


MECHANICAL HANDLING STANDARDIZED BOILERS WATER TREATMENT...

AND GOOD OPERATION COUPLED WITH GOOD MAINTENANCE...

SURE WAY TO LOW-COST STEAM

Fuel—its cost, availability—has a big bearing on what equipment goes into your plant. But no matter what it is, there are many tried and true money-saving ideas you can use. *Next page*



EXTERNAL WATER SOFTENING usually controlled in the power plant is proving its worth in small plants not only for boiler room but also for all process-water needs

Here are some quick checks to make now on operation, plus some groundwork to start you off for future planning

► THE JOB OF GETTING low-cost steam is two parts planning and one part operation and maintenance. More often than not the plant engineer is charged with the proper blending of these parts.

If you've got an old plant on your hands, then it's too late to get the perfect blend above. But you can hold costs in line by proper selection of fuel and close control over operation and maintenance. This will give you at least two of the vital three parts. Paragraphs below can help you if you're in this fix.

Good Operation. A few general rules apply no matter what kind of fuel you burn. For instance, you have to start with basic things like knowing the time-honored three T's of good combustion —time, temperature, turbulence—understanding that your equipment was designed originally for a certain fuel and performs best with that type. Remember, fuel-burning equipment is largely mechanical so it needs regularly scheduled maintenance.

Make sure that whoever you put in charge of your boiler plant knows his job and your equipment. Recognize the load limits your equipment can carry and don't make it carry overloads. Also make sure that boiler operators keep air and fuel feed in the proper relation and that air is distributed correctly. Last, hold drafts to recommended levels for the fuel you're handling and the way you're firing it (see "Underfeed Stokers" etc, below).

If you can do anything about keeping your fuel clean both in storage and in handling put it in effect right away. Ordinary housecleaning precautions along this line pay good dividends.

You can go beyond the normal boiler-room operating procedures above to improve your plant efficiency. Mechanical handling equipment from coal pile to ash removal can smooth out operation and reduce labor costs, if you fire coal (See page 86). If it's an oil-burning plant, you can add good storage facilities plus mechanical aids like ample

UNDERFEED STOKERS

Avoid overloads and attendant high burning rates. A change to higher-quality coal may reduce effect of overload.

Keep fire out of retorts. If burning in them occurs, look for too-thin fuel bed, empty hopper or improper banking.

Make sure fuel feeds uniformly over grate. Change position of secondary rams or pushers until you get uniformity.

See that grate-bar ends are always covered. Don't remove ash or clinker that stays on grate bars after dumping. Let normal stoker operation bring it down.

Learn proper fuel-bed thickness for your coal. It runs about 5 to 7 in. for single retorts; 14 to 18 for multiple.

If fuel bed is too heavy, fire becomes uneven, air distribution falls down, holes develop, smoke forms. Too light a bed may produce retort troubles.

Don't work the fire more than needed. Even out the fuel bed by lightly raking the surface. Forget about the slice bar.

Hold overfire draft to about 0.1 in. A rule of thumb for underfire draft calls for 1.0 in. for each 10 lb of coal burned per sq ft per hr.

Always keep a flow of air through the grates except when on the bank.

Maintain a clean fire and clean ashpit.

CHAIN, TRAVELING GRATES

Maintain an even fuel bed. Rate of ignition controls grate speed and fuel-bed thickness.

Air flow directly affects ignition. Be constantly on guard against air leaks into the furnace. Such leaks break down the pressure difference across the fuel bed, lower the ignition rate.

Natural-draft grates have about 20% air space. Below 0.1-in. draft, overheating of grates may be encountered. Too high gas velocities, and you run into cinder carryover. Usual range is 0.1 to 0.15 in.

Forced-draft units have 7 to 10% air space in the grate. The draft loss across the fuel bed runs from about 1.5 in. to 2 in.

Stoker design provides for regulating air flow to different zones of the grate. For best results, air distribution must be adjusted carefully and maintained at correct flows.

Keep ashpit and under-grate areas free of siftings. Neglect can cause warping with the consequent loss of control of the air flow.

Make sure the mixing is thorough. If it's not adequate, install overfire jets. They're not a cure-all, but used correctly they do improve faulty firing.

preheaters to extend the range of satisfactory fuel oils.

Water treatment is a good general maintenance tool that improves any plant's operation. Properly handled it reduces required blowdown losses, extends boiler availability and lengthens the life of metal parts.

For the new plant there are all kinds of possibilities. The Perfection Stove Co is a good example. They recently modernized their Ivanhoe Plant, Cleveland, Ohio, and took care to get in all three of the needed parts to low-cost steam supply—good plant layout and equipment, flexible fuel choice, sound operating program. First step was choosing a flexible, low-cost fuel.

Proper Equipment. They made bituminous coal their basic fuel because the plant was close to a large supply. Since the available bituminous coals were the caking type, some form of stoker seemed in order. What's more, they wanted to take advantage of strip instead of deep-mine coal. It meant a saving of $3.50 per ton. The particular design had to be the one best suited to their plant load, one that could successfully go on bank, carry light loads and occasionally pick up sudden emergency loads of considerable magnitude. At the steaming range they wanted, 30,000 lb per hr per boiler, the single-retort underfeed unit filled the bill nicely.

A proper-sized stoker of this type not only meets the desired savings but is not likely to create any smoke or fly-ash nuisance. One smart idea they used in deciding on proper stoker size was to rate stoker output on active grate area rather than total.

Stoker Rating. They reasoned that, while some air comes in through the retort and the dump-grate sections, the amount of burning in these regions is far less than that over the live-fire area.

Combustion Engineering-Superheater Inc* suggests one way to determine this active grate area. Their findings indicate the width of the retort and the dump-grate sections run fairly constant for any width stoker. The important variable-length of grate bar varies almost directly with the total width after making a fixed allowance for retort and dump grates.

With this background, they set up a table of allowable coal-burning rates per square foot of grate that changes with stoker width:

Total stoker width, ft	*Lb per sq ft per hr*
6	24
7	27
8	30
9	31
10	33
11	34
12	36

This is the kind of thinking that went into Perfection's choice. Their thoughtfulness paid off. They've been able to burn Ohio strip coals efficiently and avoid air-pollution troubles. Boiler efficiencies have run 80 to 85% with CO_2 readings of 13% on a 35% excess-air supply.

Plant Layout. Next step in building for lower steam costs is providing a good plant layout. Starting from scratch, as at Perfection, you select the best equipment, then arrange it in the plant to give peak flexibility as well as lowest labor requirements. With any plant, new or old, mechanized handling of coal and ash can improve layout and reduce labor costs.

The same holds true for oil. Good layouts for oil handling and storage free you from many sure-to-come maintenance headaches resulting from a hasty installation, POWER, Sept 1951, (p 109).

This phase of good layout is one that can come up at any time, particularly for an older plant. The present fuel situation can develop pinches. It's smart operation to know whether you're equipped to get peak flexibility with the fuel you're using or whether you ought to start looking for an alternate.

But no matter what your decision, base it on all factors that give long-range operating economies. Don't get caught in the position where every move you make is forced on you, or is an out-and-out desperation measure.

*"Reducing Steam Costs in Coal-Fired Steam Plants," by C. E. Miller, *Combustion*, March 1951, p 43-46.

SPREADER STOKERS

Too high a percentage of fines may put too much of coal in suspension for furnace volume and available combustion time, cause excessive dust emission.

Keep a thin, level fuel bed; a heavy one clinkers and smokes.

Both under- and over-fire draft should be held relatively low, at values consistent with a slight negative furnace pressure.

Low windbox pressure, with relatively high grate resistance avoids heavy fluctuations as fuel-bed thickness changes, also excessive cinder carryover and, in extreme cases, blowholes. Holding overfire draft low avoids high gas velocities. It's a good idea to restrict fuel feed to about a minute's supply.

Remember that rate of ignition drops on low-load operation and smoking can develop as a result.

Clean fire pits and ashpits at regular intervals. Siftings in ashpits, once ignited, can damage grates, cause loss of air control.

Set up the correct banking procedure and follow it.

Check damper positions, baffle condition and furnace walls periodically. They assure even gas travel; prevent dangerous back-pressure build up.

OIL AND GAS

Watch burners for wear caused by abrasion of ash in fuel and for carbon buildup.

Always protect cup of rotary burner after it is turned off, otherwise carbon forms in rim, spoils atomization.

Worn or carbonized mechanical-atomizing nozzles play hob with combustion; replace worn nozzles, keep them clean.

Many smoke troubles arise from faulty air supply. If installation is hand controlled, make sure air supply is regulated when oil flow is changed. Keep air inlet and fan blades clean. Clogging dirt and line cut air flow; smoke may result.

Smoke may be produced in starting a cold furnace. If preheating steam isn't available, use light oil till furnace is hot and preheating can be done. Always start with moderate flame, shifting to high when furnace warms up.

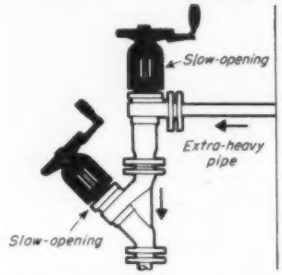
Watch out for formation of "carbon mushrooms" on walls of a cold furnace.

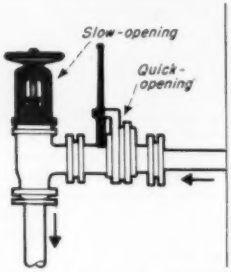
Avoid overloads. If multiple burners are installed to vary load, be sure any burner taken out of service is removed from the furnace to avoid carbon buildup. Watch out for "dribbling" when burners are shut down. If the burner dribbles, check valves. Make indicated repairs. Keep fuel-feed pressure even. Variations cause flame fluctuations.

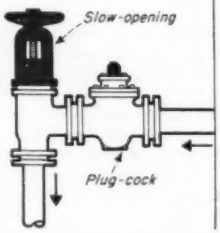
OPERATORS' NOTEBOOK 52

Handle Blowoff Valves

ASME CODE REQUIREMENTS

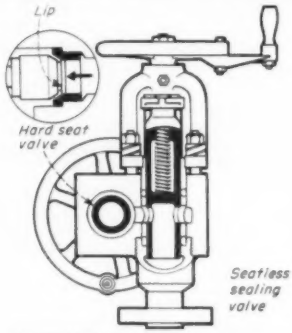




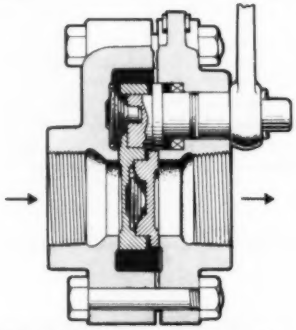


PARAGRAPH 308, *ASME Code for Power Boilers,* requires all boilers carrying over 100-psi working pressure, except traction or portable boilers, to have two blowoff valves on each blowoff pipe. These may be two slow-opening valves, or one slow-opening and one quick-opening valve, or one slow-opening valve and one plug cock. Traction and portable boilers must have one slow- or one quick-opening blowoff valve. On all types boilers, connect the blowoff valves with only extra-heavy pipe

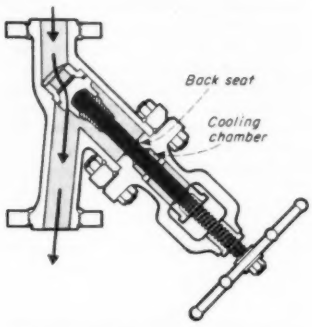
DETAILS AND OPERATION



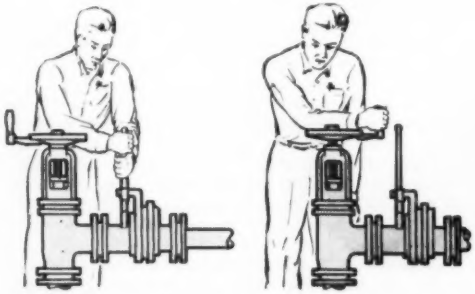
COMBINATION seatless sealing valve in same steel block with hard-seat valve, 400-2500 psi. Lip protects seat from wire-drawing. Ported valve needs no seat



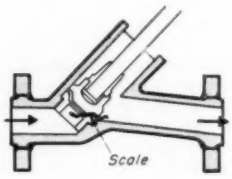
QUICK-OPENING valve, up to 600 psi. Spring holds disk to sealing surface of port. That keeps grit off sealing faces. Disk rotates in use, keeps joints tight



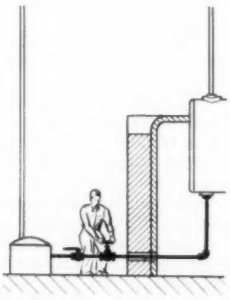
STRAIGHTWAY flow, good to 600 psi. For back-seating to pack under pressure with valve open. Straight passage of sediment prevents scale clogging or eroding



BE CAREFUL when blowing boiler. First open quick-opening valve slowly. Then open slow-opening valve slowly enough to prevent shock, but fast enough so seat won't wiredraw. To stop blowing, close slow-opening quickly, then fast-opening



NEVER jam valve if it won't close. Open few turns fast to clear, close again slow. Jamming on scale wire-draws

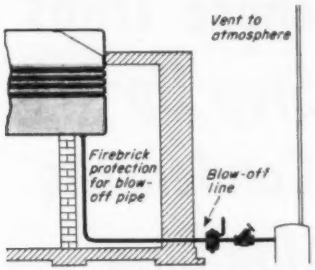


BLOW when boiler has banked fire or low loads — sediment settles more then. *Watch glass, don't leave open valve*

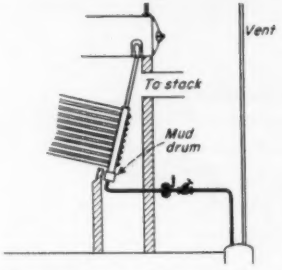
With Kid Gloves

By STEVE ELONKA, *Associate Editor*

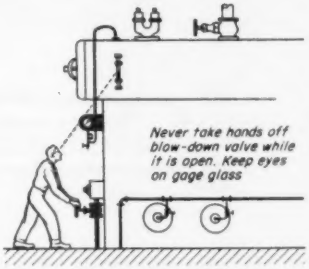
USES



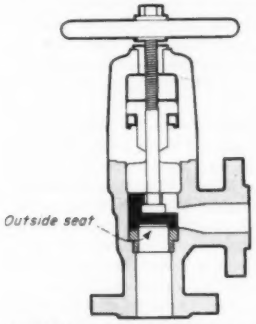
EMPTY cold boiler through blowdown line for cleaning, inspection or for repairs. Don't empty until water is fairly cool, or boiler seams and joints warp, leak



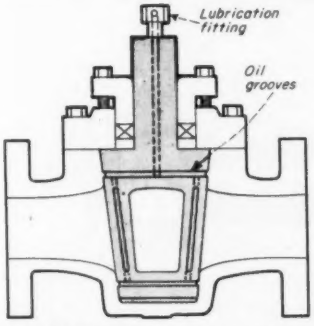
BLOW OUT mud, scale or sediment while boiler is steaming. *Caution:* Make sure blowdown valves are closed on idle units or scalding water will blow into them



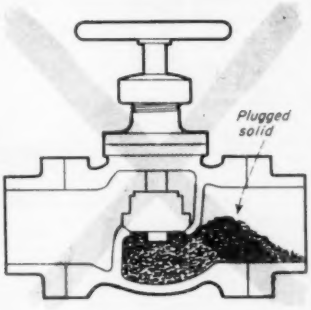
BEFORE CUTTING boiler in on line, give blowdown to reduce the alkalinity. This prevents carryover. Test the water and give blowdowns until water is just right



ANGLE blowoff valve, 200 psi. Seating surface is on *outside* of seat ring. That protects seat from cutting effect of the water, scale and sediment passing through



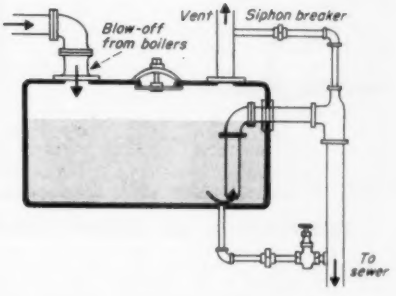
PLUGCOCK, 175 psi. Plug is pressure-lubricated through stem so tapered cock turns easily. Since valve opens, closes by turning, seating surfaces stay clean

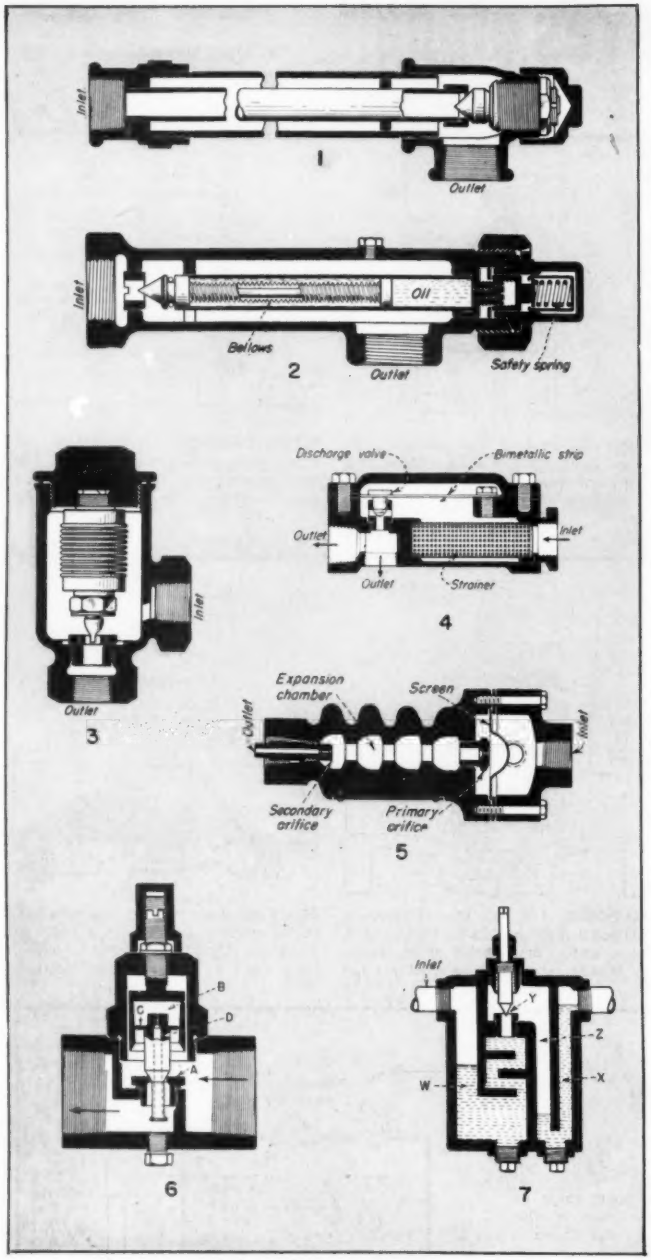


DON'T use globe valve on blowdown line. Pocket in valve clogs with mud, sediment and scale. Then boiler cannot be blown, valve can't be cleared under pressure

HERE ARE BLOWDOWN TANK DETAILS

Tank prevents damage. Blowing directly to sewer instead of to tank blows hot water and steam in other sewer connections. This tank is always full of water. When hot water blows in, cooler water in bottom overflows to sewer as it's displaced. Large open vent prevents backpressure. Small siphon breaker keeps tank from emptying. Manhole is for internal inspections





THERMOSTATIC AND THERMODYNAMIC TRAPS

Thermostatic trap, Fig. 1, has central tube that expands when steam reaches it. 2: thermostatic trap uses oil in central tube to produce closing force. 3: balanced vapor-pressure trap. 4: thermal trap. 5: orifice or labyrinth trap. 6: impulse trap has two orifices in series. 7: this trap has a hand-adjusted orifice

These Traps Step Up Condensate Handling

► LAST MONTH we found that mechanical traps give intermittent or continuous discharge, depending on type. Condensate temperature is often the same as steam temperature. Now let's take a look at some thermostatic and thermodynamic traps. Don't let the big names scare you.

Thermostatic Traps. Temperature change opens and closes discharge valve in this type. At a given pressure, saturated steam has one temperature, and only one. Condensate formed from saturated steam has same temperature as steam.

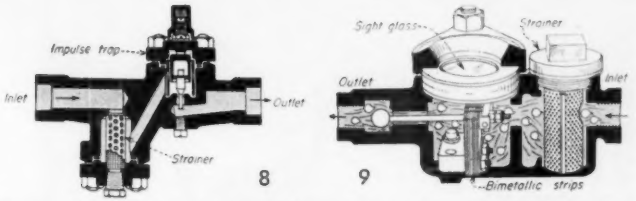
Trap, Fig. 1, has bronze or stainless-steel expansion tube fitted with discharge valve seat at one end. When you turn steam on, discharge valve is wide open. It remains this way until all air and condensate are discharged. When steam reaches center tube the metal expands, closing discharge valve. After enough condensate collects and cools in the central tube the tube contracts, opening discharge valve.

The colder the condensate entering this trap, the greater the valve opening. When equipment drained reaches normal temperature, trap discharges continuously.

In oil-filled trap, Fig. 2, change in temperature causes oil charge to expand or contract, closing or opening discharge valve. Thermostatic element is downstream from valve. Air and cool condensate discharge when you turn on steam.

As soon as steam reaches oil charge the oil expands, closing valve. After a while, oil cools, opens valve slightly. If there's condensate in trap, it passes, but if steam is present valve closes again.

TWO TRAPS FITTED WITH INTEGRAL STRAINERS



Traps with integral strainers need fewer fittings when connected into a line, are easier to maintain. 8: impulse trap. 9: thermal trap has flow sight glass

Thermostatic and thermodynamic traps have many uses in your plant. Here's the dope on how they work. You'll be better able to pick and maintain a trap when you know what it can and cannot do for you

By TYLER HICKS *Associate Editor*

Action can be either intermittent or continuous and depends on the rapidity with which trap body loses heat to surrounding air. Safety spring protects against damage from overexpansion.

Both these traps (Fig. 1 and 2) can be adjusted to deliver condensate at a temperature other than that corresponding to pressure in line. Neither freezes outdoors. Traps like these have many uses.

Balanced vapor-pressure trap, Fig. 3, uses a volatile liquid or a volatile liquid-water mixture under slight vacuum. Atmospheric pressure compresses bellows against a stop when you first turn steam on. Valve stays open until all air is driven from system. When steam reaches trap it vaporizes volatile-liquid mixture and raises vapor pressure high enough above that of steam to expand bellows and close valve.

Bellows' internal pressure slowly falls when cool condensate or air collects in trap. Line pressure lifts valve allowing condensate and air to escape. Discharge temperature is less than that of steam. Trap works intermittently.

Thermal Trap. Bimetallic strip, Fig. 4, makes a simple trap for light condensate loads where positive trap action is not important. Use units like this for thermal air valves where very rapid heating and air removal are needed.

When you turn on steam to this trap, cold air hitting bimetallic strip makes it contract to open discharge valve. Condensate and air pass through trap until steam hits strip, causing it to expand and close valve. These traps won't freeze outdoors, work intermittently.

Another design of thermal trap is shown in Fig. 9. Bimetallic element has three or more sections, each with a number of blades clamped at one end. Element supports and closes the free-floating valve.

When you start up, air and cool condensate flow past bimetallic strips and out discharge. Condensate pressure acting on valve face opens valve and keeps it open. As system warms up, hot condensate enters trap, leaves and is followed by steam. When steam contacts bimetal, it deflects and snaps discharge valve shut. Ball discharge valve acts as a check valve when there is backpressure in the return line.

Thermodynamic Traps. Also called orifice or labyrinth units, these work on the principle that steam or condensate at steam temperature expand to a larger volume when discharged to a lower pressure.

Trap in Fig. 5 has four expansion chambers between the inlet and outlet orifices. When you turn on steam, air is pushed through trap to discharge. Cool condensate follows and doesn't flash into steam because its temperature is too low. But when hot condensate reaches trap, part flashes to steam, choking off the passage.

Orifices in trap are sized so condensate below steam temperature passes freely. Discharge is continuous at a temperature below that of steam.

Impulse trap, Fig. 6, discharges continuously when load is heavy, intermittently when load is light.

When you turn steam on, pressure of air and condensate on under side of control disk *C* lifts valve like a piston. Air and condensate pass out main orifice *A*, a small amount (called control flow) flowing up past disk. It goes to control chamber *B*, which is at a lower pressure. From chamber the control flow discharges through a control orifice in the top of valve stem *D* and passes to trap outlet.

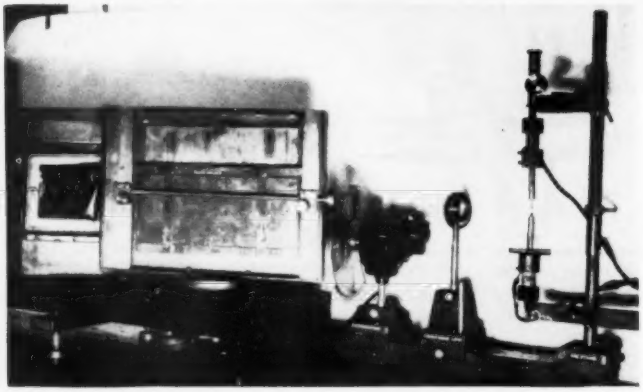
As condensate temperature goes up, valve floats in open position because reverse taper of control cylinder *B* varies flow around disk *C* until pressures above and below balance valve. With condensate very hot and steam just behind, condensate entering control chamber flashes into steam. Volume of mixture in chamber increases greatly.

Larger volume chokes off some flow through control orifice, building up pressure in *B*. Greater effective area above disk produces larger total downward force, closing valve and shutting off main discharge.

Impulse traps are suitable for draining many different types of industrial units, are non-freeze, and can be made with integral strainers, Fig. 8.

Hand-Adjusted Orifice. Trap in Fig. 7 has a receiving chamber *W* and discharge chamber *X* with an adjustable orifice *Y* between. Horizontal baffles below orifice allow condensate flow when its temperature is less than that of the steam.

Flow falls off when temperature rises until inflow is greater than outflow because the hot condensate flashes in chamber *Z* and chokes discharge. Air entering chamber *W* pushes water level below sealing baffle and passes up through orifice. Condensate discharge is continuous at a temperature less than that of the steam in the line.



SPECTROGRAPH UNIT has condensing lens to focus arc on the collimating lens in front of prism. Note also adjustable interrupter and electrodes at the far right

OIL ASHING in porcelain crucible. Then ashes are burned at 1000 F for 20 min

DIESEL-OIL ASHES...

tell this inside story

- *Corrosion knocking out engine*
- *Engine deposit buildups*
- *Diesel ripe for crankcase explosion*
- *Material failures*

By **RAY McBRIAN**, *The Denver & Rio Grande Western R R Co*

Grating Spectrographic Analysis

Parts Per Million

Element	*Symbol*	*Freight diesel miles 14,000*	*5,000*
Silver	Ag	1.5	0.21
Zinc	Zn	2.0	Trace
Calcium	Ca	445.0	155.0
Copper	Cu	*50.1	*5.7
Magnesium	Mg	2.8	0.17
Barium	Ba	Trace	Trace
Strontium	Sr	Trace	Trace
Nickel	Ni	2.15	0.10
Aluminum	Al	3.8	Trace
Tin	Sn	*15.0	*0.45
Lead	Pb	*10.0	*2.25
Iron	Fe*	1310.0	*14.7
Manganese		3.6	0.33
Chromium	Cr	4.3	0.02

*See references in text.

► OVER ONE MILLION MILES of service had been obtained on the Rio Grande from the original fleet of 5400-hp diesel freight locomotives. After this million miles, we still had 96.5% of all liners and pistons in service, and about 70% of all main bearings. Of original crankshafts, 95% were in service.

As a result of present long periods between lube-oil drains, saving in new diesel lube oil alone amounts to $50,000 annually. We found that changing oil gave us greater wear in long run than leaving old oil in. Why? Because new oil has an affinity to combine with metal surfaces and corrode or wear more than old oil. Here's what led to these substantial savings.

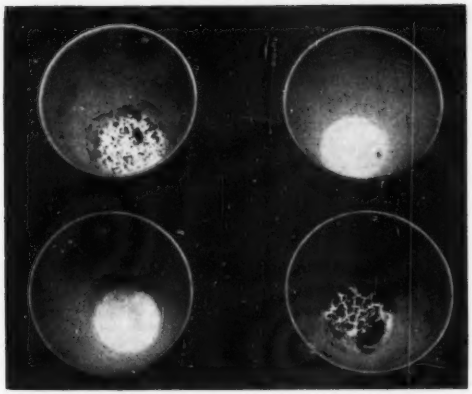
Spectrograph Analysis. We decided that control of diesel-engine lubrication and service performance could be largely regulated as problems of chemical reactions in the engine crankcase. That was in 1941, when our railroad received the first diesel electric locomotive.

By interpreting various routine analyses of used oil from each crankcase, we would know what was going on inside the engine. If interpreted right, we might beat to the punch: serious failures due to wear, corrosion, crankcase explosions, engine deposit buildups, material failures and others.

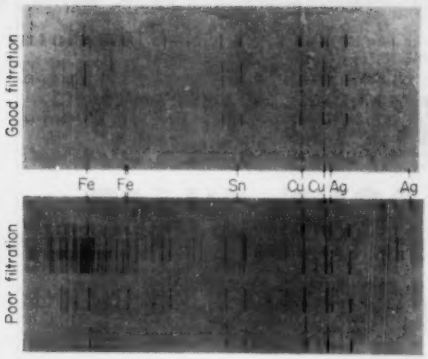
Besides daily test of flash, viscosity, dirt and water, we make spectrographic analyses from prepared crankcase-oil ash samples. We get these by burning a 20-gram oil sample from each engine. On diesel freight and passenger locomotives, a set period for ash analysis is at least every 60 days. But with various odd units, we make an analysis whenever we feel it is needed. That depends on service requirements and on our experience with the units.

What Analysis Shows. With help of spectrographic analysis, engine failures can often be detected in early stages. That prevents costly road breakdowns and damage to other parts of engine. Test is the semi-quantitive analysis of lubricating oil for both soluble and insoluble contaminants; metallic deposits found on the crankcase screen; deposits of muck on bearings, gears and other such parts; oil-line residues, and valve scales.

Excessive amounts of certain elements detected in oil give a hint to location of improper operation. Then mechanic



ASHES: *upper left*—normal used oil; *right*—unused additive oil; *lower left*—nonadditive oil; *right*—used additive oil



TYPICAL SPECTROGRAMS. Upper shows low wear rates. Lower shows high wear that is due to poor oil and air filtration

is advised what to check. That saves time in finding the difficulty. In this way, some abnormal operation or condition is corrected in early stages before further and more serious damage is done.

You must know materials of various engine parts, along with metallic constituents of lubricants, fuel, and water-treating chemicals in use. Also, engine's general operating conditions. With all this information, you can arrive at sound analytical conclusions.

We have learned that analyzing lubricating oils is one of most helpful ways to know mechanical conditions due to engine operation. Amounts of elements in oil may help to measure wear rates of engine parts, or show deterioration of additives in a detergent oil. But these don't mean as much to us as ratio of quantities found when some abnormal condition exists.

Over a period of time, we take spectrograms of lube-oil ashes from various engines. As experience grows, relative amounts of elements found in ashes of various types of engines become known. A gasoline engine under normal conditions will contain more and darker lead lines in spectrum of oil than a diesel engine. But these lead lines will be much less intense than in a similar gasoline engine having a poorly adjusted carburetor and thus abnormal dilution.

Trouble-Shooting. If air-filtration system is poorly maintained, road-dust elements appear in large amounts in oil. These are silicon, aluminum, titanium and magnesium. Bearing corrosion is detected by bearing metal's spectrogram, in solution in lubricating oil. These metals are the following: copper, tin, lead, antimony, silver and cadmium.

Excessive wear or abrasion is also indicated in this way. Then you'll find iron and aluminum, which may also be from poor oil filtration. With detergent oil, appearance of additive elements' lines in spectrum is a good check of amount of detergent left in used oil.

Chromium is one of elements commonly found in water-treating chemicals. So if you don't have chrome-plated rings or liners, excessive amounts of chromium must come from cooling-system leak.

Equipment Needed. Oil samples are taken directly from each diesel-engine crankcase. Sampler is a suction oil gun, with a long copper tube to fit into oil-dip-stick hole.

Then oil samples are taken to laboratory for spectrograph analyses. Twenty grams are placed in porcelain crucible and oil is ashed. After ashing, oils are burned in muffle furnace 20 minutes at 1000 F. Typical results are shown in left-hand photo, this page.

Upper left-hand ash sample is from normal, used diesel oil; upper right is ash of unused additive oil; lower left is ash from crankcase of non-additive oil; and lower right is sample of used additive oil showing large contents of impurities. These ashes are analyzed spectrographically to determine metal pickup and relative amounts in sample.

A tiny steel measuring tool is used to place ash sample on electrodes.

The spectrograph unit consists of a condensing lens that focuses arc on collimating lens in front of the prism. The slit is fixed at 30 microns. An adjustable interrupter, between the condensing lens and the slit, is rotated over 1800 rpm during the exposure.

The 60-second arcing period is divided into three 20-second continuous exposures, either by racking the plate or moving the Hartmann diaphragm each 20 seconds while arc is burning.

Typical spectrograms obtained are shown in last photo. Upper spectrogram shows low wear rates; lower shows high wear due to poor oil and air filtration. For quantitative analyses, typical results are shown in table.

Engine at 14,000 miles shows great increase in iron, copper, tin and lead. (See asterisks in table.) Here bearing trouble and crankshaft wear were detected. We stopped them by making repairs. That prevented crankcase failure and serious road failure.

We also found by this quantitative spectrographic analysis that presence of 10 parts per million of silicon (usually from road dust) causes a ring-gap opening beyond condemning limit at 60,000 miles. But if silicon is kept below 5 parts per million, it permits rings to go from 250,000 to 400,000 miles before gap limit is exceeded.

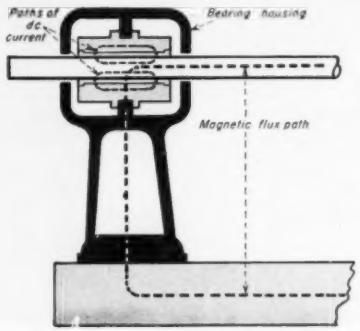
It follows that reducing wear on the piston rings also cuts down wear on cylinder liners in direct proportion.

By this control, the Rio Grande has secured 300,000 to 400,000 miles between oil changes of main-line diesel freight locomotives. Besides, wear rate on engine parts is extremely low. Main reason for draining at 300,000 to 400,000 miles is that our major overhaul period falls at that time. So oil is then drained, reclaimed, and reused in other locomotives. These tests have proven a great help in preventive maintenance.

WHAT TO DO ABOUT SHAFT CURRENTS

By JIM SPARKS, *Superior, Wis.*

A—PROBLEM: BEARINGS PITTED...



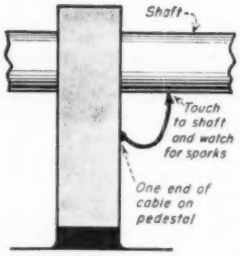
1 Flow of magnetic flux through shaft and uninsulated bearing will induce dc bearing currents in this case

B—DETECTION: CONNECT MILLIVOLTMETER BETWEEN TURNING...

Now that you know what the problem is, let's scan some of the more practical ways of spotting it in your machines. Simplest is to connect shaft and bearing pedestal temporarily with a heavy cable, Fig. 3. Bolt one end of cable to pedestal, then touch other end to rotating shaft. If you *continue* getting sparks between cable and shaft, it means bearing currents are possible. But this check won't tell if there's enough current to do any harm; see Fig. 4, 5.

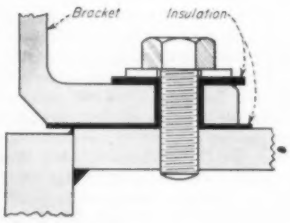
Checking pedestal insulation, Fig. 4, calls for ac-dc millivoltmeter. With machine running, connect instrument between shaft and bedplate, paralleling pedestal insulation. Reading will be volt drop across pedestal insulation and oil film in series. Then short-out oil-film "resistance," connect millivoltmeter between bedplate and pedestal. If reading is less, insulation is bad.

To understand this test simply visualize oil film and bearing pedestal insulation as two resistors in series. With no current flowing there is no difference in voltage if either shorts out. And that's just what we do when cable connects pedestal and shaft. Normal resistance in oil film between shaft and bearing is shorted out changing voltage drop. If no current flows in first place, there's no difference in voltage with oil film shorted out.

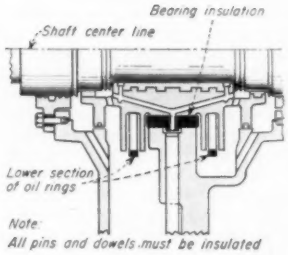


3 Touching pedestal and spinning shaft with cable is a rough trouble test

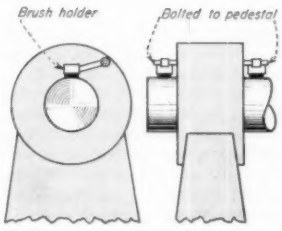
C—SOLUTION: INSULATE PEDESTAL BEARING OR SHUNT IT OUT...



6 Fish paper will insulate the bearing bracket. Don't cover with lead paint

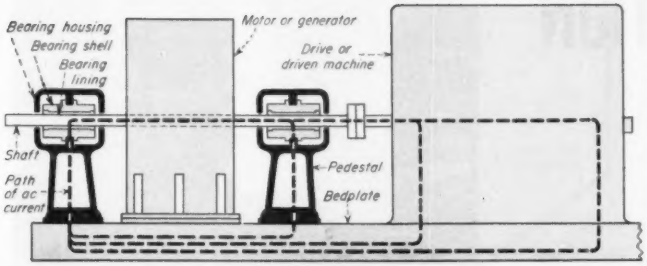


7 Better way is to insulate the bearing itself inside the bearing enclosure



8 Quickie: Try attaching bracket to the pedestal letting brush ride on shaft

...BY FLOW OF CURRENT INDUCED IN MAIN SHAFT



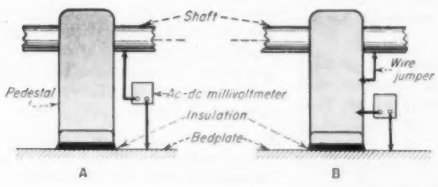
2 Here there is an actual flow of ac current through shaft and bearings. Even slight magnetic unbalance in machine will induce an ac voltage in the shaft

This business of shaft currents can cause a heap of bearing trouble. Headaches come because current pits bearings in going from shaft to pedestal.

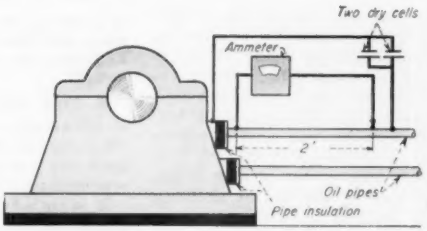
Any magnetic unbalance within machine generates voltage in shaft. It's this voltage that circulates ac current through shaft. To get complete circuit, current will leave shaft at bearing, skirt across bearing oil film, through machine base, then back to shaft through other bearing, Fig. 2.

In dc machines you may have problem of magnetized shafts. Result may be dc bearing currents, Fig. 1. Magnetized shafts come to being when load current makes one uncompensated loop around shaft. It can do this through commutating, series fields.

...SHAFT AND MACHINE BEDPLATE



4 Check bearing insulation by comparing readings *A* and *B*. If same, insulation OK; expect trouble if *B* is less than *A*



5 Use this battery-ammeter combination to check insulated joints. Insulation is bad if the ammeter needle moves

...WITH BRUSH RIDING ON SHAFT

There are several solutions to problem of bearing currents. Basically it's a matter of insulating one bearing to prevent a complete circuit between shaft, bearings and bedplate. This circuit is needed whether it's current or magnetic flux we are dealing with. Here are a few guides.

As mentioned, best way to eliminate ac bearing currents is by insulating one bearing. This should include the holding-down bolts, dowels, oil piping and grounded connections. Then if insulation is kept clean and in good condition there is no further path for current.

For dc bearing currents, your aim is to reduce magnetizing force around shaft. This is not a simple job. May be best to get manufacturer's advice. But you might try insulating bearing to reduce flux. This in itself cuts internal circulating currents. Reduction by this step alone often eliminates bearing damage.

As shown in Fig. 8, you can side-step insulation and still eliminate bearing currents. Here you simply add brush holders to bearing pedestal and let brushes ride on shaft. For this job select brushes with very low resistance—much less than resistance of bearing-oil film. You'll find metal graphite brushes with high copper content fit the bill. This method usually reduces bearing currents to safe value. Drawback is brush maintenance.

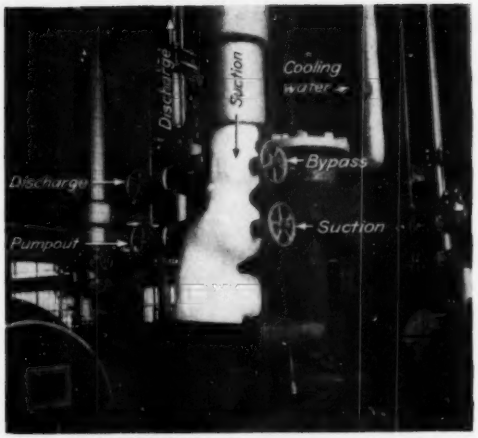
Proper oil maintenance tends to reduce effect of bearing currents. A good, clean oil film increases resistance to current flow. This film acts as an insulator as long as a full-fluid film exists between shaft and bearing. However, insulating value of oil film drops when bearing operates in thin-film or boundary region.

Even if manufacturer insulated bearing, recheck from time to time. Dirt is common cause for shorting it out.

REFRIGERATION Q & A

By HARVEY C WELCH
Retired General Manager, American Ice Co

18 questions often asked for unlimited refrigeration engineer's license



AMMONIA COMPRESSOR has header with a discharge, suction, pumpout, bypass, safety valve, all cast in one compact unit

Q 1—What are the general requirements for ventilation in refrigerating machinery rooms?

A—This varies with amount of refrigerant in system, type of refrigerant, and whether ventilation is natural circulation or forced-draft. Thus, class-A system with over 1000 lb refrigerant needs (a) exhaust fan with capacity of at least 2000 cu ft per min or (b) window areas to outside air of 25 sq ft if on opposite walls or (c) 60 sq ft if windows open on one side of machinery room. See your local code.

Q 2—Can the ammonia condensers or discharge line be pumped out by the standard type of ammonia compressor in case of leaks?

A—Most compressors are fitted with bypass and pump-out valves, on machine header, besides the main suction and discharge valves. For normal operation, suction and discharge valves on header are open. Reversing their position permits pumping gas from discharge line, discharging it into the suction side of the system.

Q 3—Are open-flame lights permitted in the machinery rooms?

A—Arc lights or other open-flame lights are not permitted.

Q 4—How many helmets and gas masks are required in a refrigerating machinery room? Where should they be located?

A—Class-A systems, with over 1000 lb of refrigerant, should have two masks in the machinery room, near main exit, and one or two masks at convenient points, throughout the plant. All codes approve masks approved by U.S. Bureau of Mines for refrigerant in use.

Q 5—If you are testing a new system, using anhydrous ammonia as a refrigerant, what test pressures are required?

A—Most codes require air pressure of 300-psi gage on high-pressure side, 150-psi on low side. (IMPORTANT: Take great care in pumping air pressures on systems for testing.)

It is not advisable to use large ammonia compressors for pressures in excess of 150 psi. Above this point, use a small air compressor, designed for high-pressure work, and lubricated with air-compressor oil. Best procedure is: Open all valves on low-pressure side of system. This permits placing maximum allowable pressure on brine coolers and accumulators to equalize with that of high-pressure side. Entire system may then be tested at 150 psi.

Next step, close off low-pressure system and blow out air pressure, leaving a valve open at some point to atmosphere. This prevents possibility of placing a higher pressure than would be safe on low side of system, while testing high-pressure side. High pressure is then pumped up to the required pressure and tested for air leaks. Soapy water applied with a soft paint brush at all joints is a simple way to locate small leaks.

After checking over entire system by this method, blow out air pressure, close off atmospheric connections to low side and see that expansion valves are open. Then pump a vacuum on the system, exhausting all air possible. Large compressors may be used for this purpose. System is now ready for charging. It is good policy to charge in only a small amount of ammonia, enough to raise gas pressure to 75 to 100 psi, and then again fairly test the system for small gas leaks. This may seem like a drawn-out process but, carefully carried out, it saves a lot of time and trouble.

Q 6—Are stop valves permitted between safety valves and receivers, accumulators and other pressure vessels to permit safety-valve repairs while system is under pressure?

A—No valves of any type are permitted whereby safety valves may be closed off, rendering them useless.

Q 7—If you were building a liquid ammonia receiver, say 16 in. in diameter welding in minus or plus heads, would you place the pressure on the concave or convex side?

A—On the concave side; 40% greater pressure is allowed on the concave side.

Q 8—Are brass and copper pipe fittings suitable for ammonia systems?

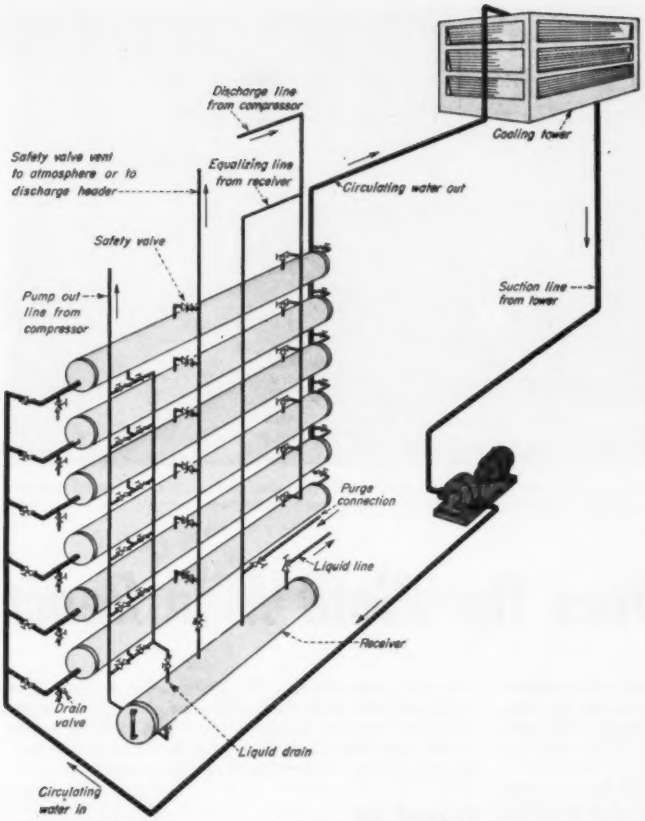
A—No. Ammonia fittings are made of cast steel or forgings. All piping should be steel or wrought iron.

Q 9—State size of safety valves required on 100-ton-capacity system using carbon dioxide.

A—One-half to ¾ inch.

Q 10—What type valves are required for liquid level gage glasses?

A—Gage glass valves must be fitted



SHELL-AND-TUBE condensers have large capacity on small floor area. This is simple piping layout for easy operation and maintenance. Flanged heads remove easily

with a ball check, which closes automatically in case of glass failure. Metal screen or slotted metal casing must protect glasses.

Q 11—Are ammonia gas and air mixtures considered explosive?

A—Most authorities place explosive limits between 17 and 25% ammonia by volume. Most serious explosions from flame coming in contact with bad ammonia leaks have been caused by mixture of ammonia gas, air, and oil vapor. There is no danger from explosion in cutting into ammonia lines, receivers or accumulators with acetylene torches or making welded connections if system is open to atmosphere, ventilated.

Q 12—What is latent heat?

A—Latent heat is required to change the state of a body without change of temperature, as in changing melting ice at 32 degrees to water of the same temperature.

Q 13—Is it possible in an atmospheric cooling tower to reduce temperature of the circulating water below that of surrounding atmosphere?

A—Yes. In a well-designed cooling tower, temperature of water off the tower often approaches wet-bulb temperature; 10 to 15 degrees below dry-bulb temperature is not uncommon, depending on relative humidity.

Q 14—Why are holes cast into the rims of flywheels and motor rotors on large units?

A—To help turn machine by hand when making repairs and adjustments. (NOTE: 60% of applicants state that these holes are for balancing purposes.)

Q 15—What would cause the discharge-gas temperature, leaving a compressor, to suddenly become abnormally high without any noticeable change in suction or discharge pressures?

A—There are several causes: (a) broken suction or discharge valve (b) broken piston rings, causing heavy blowby or leaky bypass valves (c) passing hot discharge gas back into suction side of compressor.

Q 16—What would cause discharge temperatures to drop below normal, discharge line to become cold and compressor to frost over heavily?

A—Excessive amount of liquid refrigerant passing expansion valve, causing liquid to slop over from evaporating side to the compressor.

Q 17—If you were asked to take charge of a large refrigerating plant that had been closed down for some time, state briefly how you would proceed, what precautions you would take.

A—Assuming the plant had enough refrigerant in the system and was tight, first make and inspect all auxiliaries, such as water-supply system, pumps, brine coolers or expansion side of system and condensers. Check position of all valves on high- and low-pressure sides, see that they open and close easily.

If synchronous motors are used on high voltages, take Megger tests to determine condition of insulation on motors and feeders. Check contacts on oil switches and breakers, remove covers from vertical-enclosed machines, check condition of connecting-rod bearing bolts.

Check entire oiling system. Bar over by hand large reciprocating machines, one complete revolution, and check piston clearances. Check all rod adjustments and packing boxes. In starting compressors, open suction valves slowly, as liquid refrigerant may be lying in the suction lines. After starting, check all bearings to see that oil rings are turning, as they often fail to start when units are shut down for prolonged periods. See that your plant is supplied with adequate safety equipment—gas masks, proper fire extinguishers, first-aid kits.

Q 18—What is the purpose of a safety head in a vertical, single-acting ammonia compressor?

A—Safety head is a false head, resting on a shoulder on top of the compressor cylinder. Discharge valves are fitted into this head. Heavy springs, placed between the main cylinder head and the safety head hold the latter in position. In case of broken suction valves or heavy slug of liquid refrigerant, this head rises, preventing serious accident to the compressor.

LOWER HEATING COSTS, little or no operating troubles, better working conditions are claimed by owners of radiant-heating systems whether they've used copper, wrought iron or steel. One textile plant, above, heats two floors with the one system

How Does the Plant Man React

► SINCE THE LATE 1930's when smart outfits like A M Byers began pushing it in this country, radiant heating has been expanding. The record is full of new fields of application, special design twists. But how has it worked out? How does the plant man find it?

Here's a cross section of the answers from men operating widely different types of businesses. They selected radiant heating to meet their own individual needs, were sometimes among the first in their area to try it. The answers cover the problems a heating man has to face.

Fuel Cost

"Lowest we've ever had. About 5000 gal in the 1946-7 winter." This from John Dahl who runs a specialty millwork shop of 6000 sq ft on the northern exposure of an 11,000-sq-ft building. He goes on to say: "The 4500 sq ft on the other side of this solid cinder wall burns more, winter for winter, with a conventional convection system that you can shut down at night."

Russ Jordan, a textile contractor, had more to say on this subject: "We tacked onto the original boiler a domestic hot-water system for a washroom for 120 women employes, wall-type finned convection heaters under an outside-wall inspection table and along an outer stairwell. And yet we got by with under 11,000 gal for the worst winter we've had." Some record for a 5-yr-old wrought-iron system embedded in concrete. And even more impressive when you realize this two-level building draws its heat for both floors from the one system, photo, top of page.

When the job went in Martin Christesen, the design engineer, and Atlantic Pipe Bending & Fabricating Corp, the suppliers, decided to support the 3½-in. concrete pad with its embedded piping on bar joists. Under the pad they suspended a wire mesh with a heavy paper covering. This paper and mesh were painted with aluminum paint on the underside. And this surface serves as heat radiating source for the lower floor of the building. Conditions on this floor are excellent for warehousing of finished products.

Trapped Air

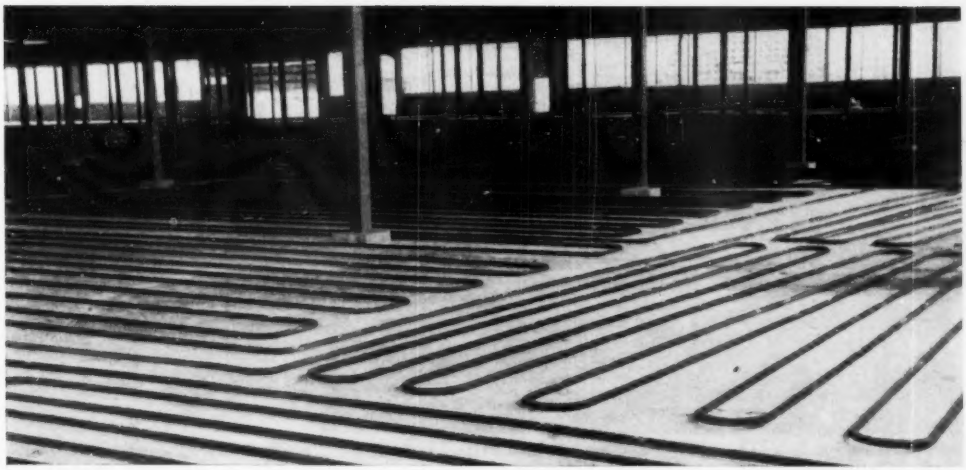
"It's no problem with the right-sized eliminator properly installed." That's the general experience of all. "You do have to take certain precautions at start-up, though," says Martin Christesen, design engineer. "When you initially fill your piping bring in fairly warm water and heat it up about 5 deg more each day until you get up to 140-150 F. That'll drive out most of the noncondensables and trapped air. But be sure to keep your pump strainers clean throughout. At start-up they usually catch mill scale, other foreign matter left in the pipe after fabrication, assembly."

Makeup

"You can put it in your eye," said J Osborne, a large-furniture-showroom operator. "We've got an over-all building length of about 400 ft with 50-ft depth, divided into four separate radiant-heating systems. You see our store has grown like Topsy. Each time we needed more showroom space we just put in another radiant-heating system, steel in concrete. Makeup is no problem at all."

Water Treatment

"No need for it." said the millwork shop, the textile plant, the furniture showroom. But Sam Nitzberg, of the Atlantic



COMPETITION is lively for materials in radiant-heating field. Two plants use plastic pipe. An expected newcomer is flexible-steel tubing. Here is Atlantic Pipe Bending & Fabricating's 86,000-ft setup of Bethlehem Rayduct for Potdevin Machine Co

To Radiant Heating?

Pipe Bending & Fabricating Corp, said a word to the wise could fit in here, especially when using steel: "Internal water problems just don't develop. Not with a good closed system where makeup is almost zero. But you can run into external corrosion and it's brought on by that old bugaboo, electrolysis. Design can beat it every time. What you have to do is be sure to put a waterproof membrane under all concrete pads. Tar paper or something similar will do. But first be sure you get the right foundation for the pad. A good underbed of gravel isolates it from the action of acid or salt-soils; promotes faster drainage of surface water."

Heat Pickup

"We don't bother to cut back the heating system at night." That's the practice in the millworking and textile plants, and the furniture shop. "By the time the concrete pad has cooled down to a low-temperature setting you have to jack it right back up so the area temperature is at the right level for your working force when they come back in. It takes quite a while to either cool down or heat up a large-sized area of concrete floor."

What effect do different floor coverings have? Here's a comment from the furniture showroom: "We use rubber tile, carpeting, carpet on tile for different sections and we can't see any difference between them in comfort conditions. As far as laying rubber tile goes you can't see any effect at all."

Working Conditions

"We insisted on radiant heating even though some felt we were pioneering," stated the textile-label contractor. "Our employes are mostly women and their work requires they sit still at machines throughout the day. We felt sure radiant heating could give even heat to all benches in all areas and spare us the complaints of too much or too little. It proved out. We're definitely sold."

"We can bring in lumber, lay it on the floor and never worry about warping," claimed the millwork man. "What's more, we can start up every heavy sawing and cutting machine right off the bat in the morning without binding or spoiling wood. Before, we had to allow time for all machine parts to warm up evenly. We don't have fine sawdust floating all over, either. And that's a blessing!"

Available Materials

"There's plenty of competition among the different metals for the radiant-heating field." (*Iron Age*, Oct 18, 1951, p 53.) "The leaders are wrought iron, copper, steel. And now even plastic has invaded the field in at least two installations. Right at the moment steel piping leads in tonnage with great hopes held out for a late starter, flexible-steel tubing."

Who Said It?

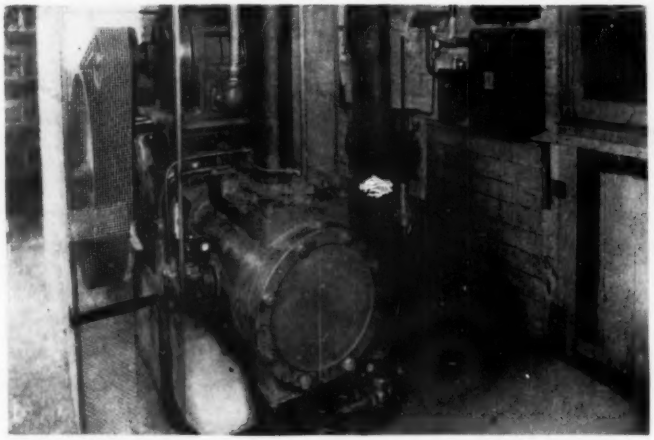
JOHN DAHL, John Dahl & Co, Hackensack, N. J., millwork shop, copper-tube system.

RUSS JORDAN, J & H Label Processing Corp, Maywood, N. J., textile-label contractor, wrought-iron installation.

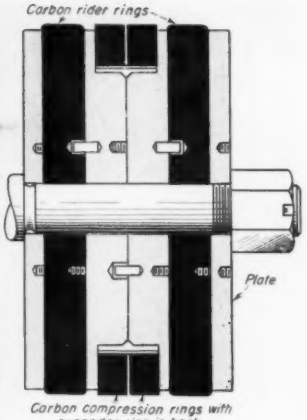
J OSBORNE, Huffman & Boyle Co, River Edge, N. J., furniture showroom, steel pipe system.

MARTIN CHRISTESEN, design engineer, Englewood, N. J., industrial, institutional, domestic radiant-heating installations.

SAM NITZBERG, president of the Atlantic Pipe Bending & Fabricating Corporation, fabricators and suppliers to the national market of radiant heating.



THIS NONLUBRICATED compressor keeps air needed for small brewery 100 percent oil-free. Life of carbon piston rings and efficiency depend on operating know-how



RIDER RINGS take load of iron piston off cylinder. Rings with expanders seal

Keep Oil Out of Air . . .

Use right carbon piston rings and piston
Don't lubricate cylinder
Keep jacket-water temperature high
Heat water when starting up unit
Run compressor continuously
Turn piston 120 deg every few months
Keep dust out of the intake air

By **N A FORAN**, *Worthington Pump & Machinery Corp*

► NONLUBRICATED COMPRESSORS are used wherever oil-free compressed air or gas is required. In many plants air comes in direct contact with the products, as in the food industry. So the air must be free of all lubricant, or any matter that would discolor, spoil, or affect taste of product.

Breweries have about the same problem. They are extensive users of nonlubricated compressors. Other industries require oil-free air for control air purposes. Air for control instruments must be free of oil or oil waste that might clog, damage or even slightly affect delicate instruments. Here again, nonlubricated compressors are needed.

Construction. These compressors are similar to standard oil-lubricated machines, above. From outside, you can't see any difference between a lubricated and nonlubricated machine.

Piston Rings. Only difference is in the piston rings, which are of carbon. Rings come into direct contact with metal cylinder since no lubrication separates these two parts. The cylinder is specially honed and polished to a fine finish. That provides an ultra-smooth surface for the carbon rings to ride on. Rough spots on cylinder surface would act as an abrasive to the carbon rings. Tiny grooves would appear in the carbon rings, thus causing a leakage loss in air compression and rapid carbon wear.

Sketch is cross section of a typical nonlubricated piston. This is commonly called the nonfloating type, because the two outside carbon or "rider" rings carry piston weight.

Two inside carbon rings are compression rings. They are segmental in design and keep an even pressure against cylinder walls. Pressure is from expander springs. So basic difference between lubricated and nonlubricated compressors is specially honed cylinder and carbon-ringed piston.

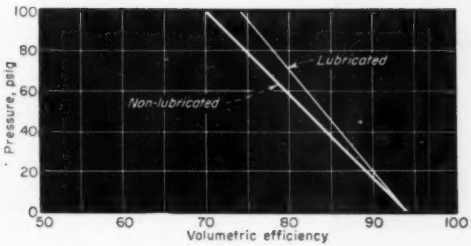
More elaborate equipment is used with some nonlubricated compressors. For example, where compressor has a very large bore, a tail rod might be best. Tail rod is extended piston rod supported by a bushing in the head end of cylinder or by an outboard crosshead.

No matter what type support for tail rod, its purpose is the same. Tail rod shares weight of large piston, thus removing load from carbon rings.

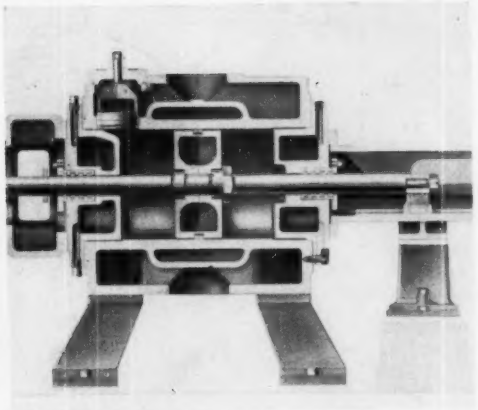
Further refinements include carbon packing, which needs no lubrication as does standard, soft fibrous packing. Also, there may be a long distance piece between frame and air cylinder. This, plus a long piston rod, prevents oil-coated rod that enters frame from also entering air cylinder.

Another design places a collar on the piston rod between the frame and the cylinder. Collar prevents oil from traveling along rod into air cylinder. This equipment is costly and, except in special cases, is not needed. For most uses honed cylinder and carbon rings are OK.

Performance of an air compressor is affected by nonlubrication. Curve, p 121, compares oil-lubricated compressor with nonlubricated machine of same size. Notice that volumetric efficiency is greater in oil-lubricated machine. This means greater air-compression efficiency, more actual cubic feet per minute and a greater volume of usable air per brake horsepower in lubricated machine.



COMPARING compressor that has lubricated cylinder with non-lubricated cylinder shows carbon-ringed job does less work



FLOATING PISTON has tail rod to take weight off cylinder. Carbon-rider rings are not needed. The cylinder wears evenly

Reason for this is that oil does two jobs: (1) Its main purpose is to lubricate the cylinder, to reduce friction, save horsepower, and increase machine life. (2) It acts as a seal between the cast-iron piston rings and cylinder. Sealing prevents air from leaking past rings as air pressure in cylinder is increased.

Nonlubricated machine depends entirely on the surface contact between carbon rings and cylinder for its seal. Obviously, the friction horsepower is increased slightly and the air leakage becomes an important factor in performance calculation. The more air that slips past the rings, the less volumetric efficiency, since this efficiency is ratio between actual capacity and piston displacement. So slightly inferior performance is penalty for oil-free air.

Another direct result of air leakage is effect it has on horsepower. Total horsepower required in nonlubricated design is less than horsepower needed in same size oil-lubricated machine. However, air slippage past carbon rings is slightly greater than with oil-sealed rings.

Part of slippage occurs after air is compressed, which is work lost. For pressures of 50 psi and higher, total horsepower of nonlubricated compressors is slightly lower than for oil-lubricated machines. That's because a smaller quantity of air is delivered. For same output power is slightly greater.

Watch Operation. Wearing qualities are an important factor in a nonlubricated machine. But wear depends largely on the operator. Manufacturer may do a fine job in building the machine, but a careless operator can wear out compressor rings in a few months.

It's poor practice to run cold water through the jackets of nonlubricated compressors. That condenses moisture in air inside cylinder, especially if intake air has high relative humidity.

Some operators heat the jacket water to 100 F or more to prevent condensation. Condensation is bad because it causes slight rusting in a cylinder. Then rust ruins honed finish, thereby wearing carbon rings more rapidly.

It's also better to run machine continuously (on bypass control) and not on start and stop. Here, again, condensation is important. Here's what happens when a nonlubricated machine is on start and stop; cylinder cools during off periods, moisture may condense on cylinder walls, even though jacket water has been turned off. That's from cold water remaining in jackets. Prevent condensation by continuous operation.

A good policy is to rotate piston about 120 degrees after a reasonable period of operation. This has effect of equalizing wear around outside of carbon rider rings, thereby increasing life.

Another important precaution is to use well-filtered intake air. Dust in cylinder acts as an abrasive on carbon rings and scours cylinder wall.

A good dry-type filter is important. Inspect it periodically and keep an accurate record. Keep records for entire life of machine.

By carefully following these maintenance tips, one Erie, Pa. operator has had over 15,000 hours of troublefree service from his nonlubricated air compressor. In all that time he needed no replacement parts. Your machine can do equally as well with proper care.

CARBON RINGS

Carbon-graphite piston sealing rings are made in various specifications. Transverse breaking strength varies from 3000 psi for softer material, up to 10,000 for harder, denser material.

Usually the harder and higher strength carbons are used in compressor rings. Crushing strength of this material varies from around 3000 to 35,000 psi for harder, stronger grades. This carbon is an electrical conductor and is nonmagnetic.

Most common design is segmental piston rings. Such rings are usually on a floating piston, which is supported by the piston rod. The shaft packing rings are also carbon, so no oil comes in contact with gas in cylinder from rod entering cylinder.

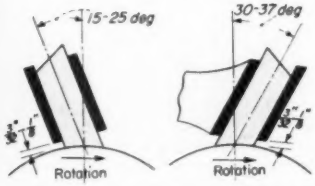
Where piston is not supported by tail rod, piston is sometimes made of carbon-graphite. Usually lap-joint piston rings are used on carbon pistons. These pistons are made longer than iron pistons to increase bearing surfaces for supporting weight of piston and rod. Then piston lasts longer.

GOOD COMMUTATION can be yours with a few simple instruments and a little know-how. Here a contact-drop test is under way. Fast check on interpoles (See Fig. 6, 7)

HERE ARE 7 SIGNS OF POOR COMMUTATION

1 Sparking at brushes
2 Streaking or grooving of commutator surface
3 Burning of bars
4 Flat spots on commutator
5 Raw copper surface
6 Heavy brush or commutator wear
7 Heating of the commutator or brushes

BRUSH CLEARANCE, ANGLE . . .



3 Brush chatter and chipping of brushes often traced to incorrect clearances

These Tips Will Pin Down Your

- ***Uneven air gaps will mean poor commutation in dc units***
- ***Armature isn't in magnetic center? More trouble***
- ***Adusting interpoles helps ease brush trouble***
- ***Brush shifting cuts sparking when done right***
- ***Brush spacing a snap with paper, pencil and clear tape***
- ***Smoke and gases play big and often unknown part in a commutation picture. Smoke increases brush friction***

► One of the big causes of commutator troubles in dc machines is poor alignment. Machine parts are made to rigid specs. So it's sloppy assembling in the field, during either maintenance or repair, that's the core of the alignment problem.

Air Gaps. For instance, take the job of positioning the field poles. The pitfall to watch for here is uneven air gaps under the main and commutation poles, Fig. 1. Air gaps under main poles should be within ± 0.005 in. of the average of all poles for gaps up to ⅛ in. Likewise, keep commutating-pole air-gap tolerance to ± 0.005 in. Where the gaps are normally over ⅛ in., keep them within ± 0.010 in. of the average.

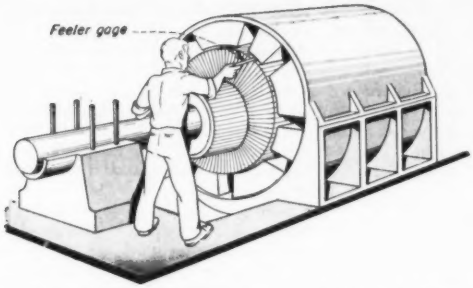
Placing the armature in magnetic center is another phase of the alignment job. This means lining up center line of armature iron with center line of main pole iron. To do this, simply measure the armature iron that sticks out beyond the main pole iron and divide it evenly between both ends, Fig. 2.

Poor commutation can stem from one of many possible mechanical and electrical causes. A good job of trouble shooting calls for a close check on loading, vibration, atmosphere and actual condition of the commutator. Some signs of poor commutation are sparking at the brushes, grooved commutator surface, burned bars, flat spots on commutator, discolored commutator, too fast wear of brushes or commutator, heating of commutator or brushes.

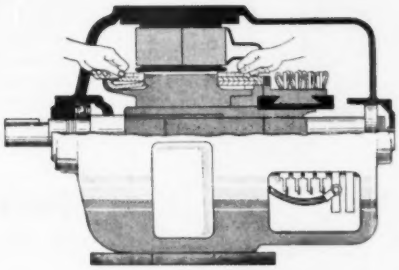
SPARKING is generally the first sign of trouble

Your first step is to look for and correct any troubles that may exist at the commutator itself; grooving burned bars, etc. If this doesn't bear fruit, look

POOR COMMUTATION OFTEN TRACED TO INCORRECT MECHANICAL MAGNETIC ALIGNMENT IN UNIT

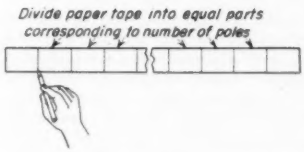


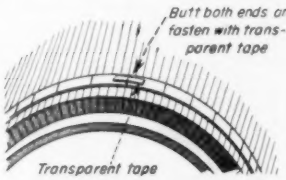
1 Keep air gaps under main poles within 0.005 in. of average for gaps to ⅛ in. Same tolerance on commutating poles



2 To line up magnetic centers: (a) measure armature iron that differs from the field poles (b) divide evenly on both sides

. . . AND SPACING ON COMMUTATOR SURFACE PLAY IMPORTANT PART IN CHIPPING AND SPARKING





4 Here's the simplest approach to brush spacing. Lay paper tape around commutator and cut at mica groove. Then spread out on flat surface and mark off in even spaces equal to number of main poles. Put on commutator, line up brushes

Commutator Troubles

By E A LECHER
Service and Erection Dept
Allis-Chalmers Mfg Co

into machine loading. Quick changes in load can cause sparking because of the magnetic lag in commutating field strength. If you can't do anything about the load, try moving the brushes in the direction of rotation. This should be done with a light hand. If moved too far, you'll get sparking at full and light load. And with a generator the voltage droop will increase as the brushes are shifted from the neutral position.

Hunting or Compounding. You can get into trouble when shifting brushes. Say, you shift brushes off neutral to stop sparking. In some machines you will over-compound if brushes are shifted in direction of rotation. So you shift them against rotation to stop sparking. Actually, the best solution would be to remove interpole shims or shunt the interpoles with a suitable resistor. But to save time you shift against rotation. Sure, sparking will stop, but let's consider the other results. When brushes were shifted against rotation the terminal voltage upped. The interpoles now have a compounding effect with brushes off neutral.

Assume the machine is an exciter under control of a voltage regulator. This compounding effect may make the regulators completely unstable. Resulting "hunting" of regulator could cause a shutdown.

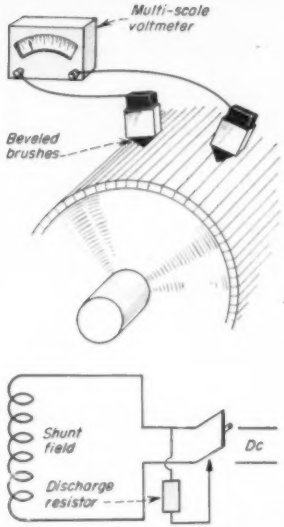
This quirk, however, can also be used as an aid sometimes. Say, you want to parallel two shunt-wound exciters momentarily. You'll meet this when putting an auxiliary exciter in and taking the main exciter out of service without removing load from ac generator. To do this both exciters must have enough droop in their voltage characteristics so neither becomes motorized during the few moments of parallel operation. You can get this droop by shifting brushes slightly in direction of rotation. Use a light hand again since in a medium-size machine a 1/16-in. movement may give a very noticeable compounding effect. It's the old story of cause and effect. So take a moment or two to predict results before making any machine changes.

VIBRATION is another major cause of brush sparking

Vibration may come from unbalance of armature or rotating element of driving generator. Also, check for poor mounting of equipment, loose couplings, poor alignment, bad belt lacing, eccentricity of commutator, sympathetic vibration (tuning fork effect) in holders or brackets, and incorrect brush angle.

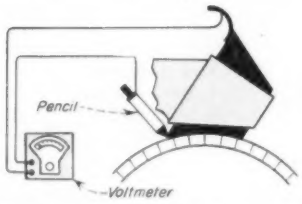
If vibration at bearing is more than .002 in. in any direction, expect trouble. You can spot vibration by first whitewashing or chalking a smooth part of the shaft. Then while shaft is rotating

TESTS FOR MACHINE NEUTRAL...

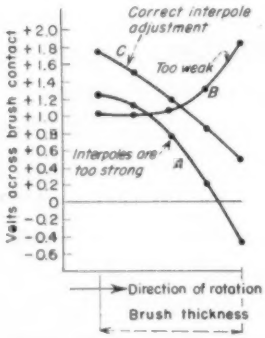


5 Inductive kick spots no-load neutral; it's the point giving lowest reading

. . . INTERPOLE ADJUSTMENT



6 Take contact-drop readings at ¼, midpoint, ¾ and at the trailing end



7 These are typical voltmeter values from brush contact-drop readings

at normal speed touch it lightly with a hard-pointed tool. Stop machine and check if line is even. If machine is dynamically balanced, the mark will be uniform around shaft. If it's uneven, you have a balancing job on hand.

Sympathetic vibration can usually be corrected by bracing brush-holder brackets. If possible remove source of vibration. Keep brush angles and clearances as shown in Fig. 3.

SPACING of brushes can stop sparking

Wrong brush spacing and incorrect neutral setting is another common cause of sparking. Probably the best way to check brush spacing is to wrap paper tape (adding-machine tape) around commutator with brushes lifted, Fig. 4. Pull paper taut and cut at overlap in a mica groove with a knife. Then remove tape to a flat surface. Divide it into equal parts corresponding to number of generator poles. This job calls for accuracy and rechecking. Each division mark on tape must be true within 1/64 in. for best results.

Then pull tape around commutator until ends butt. Secure it with transparent tape so butt joint can be seen. Use brushes that have been well seated. Place one in holder on each bracket to ride the tape. Turn armature till tape's butt-joint touches trailing edge of one brush. At this point, each brush riding the paper should barely touch a mark with its trailing edge. Adjust brackets of brushes that fail to hit a mark. Keep brush brackets 1/8 in. from commutator. This reduces brush chipping.

No-Load Neutral. There are two simple methods for finding the no-load neutral, as follows:

1. *Minimum short-circuit voltage method* hinges on locating point of minimum volt drop in armature's short-circuited coils. With machine running normal speed and voltage at no load, connect a low-scale voltmeter to two hard-lead pencils held one-bar width apart. Pencils touch commutator where you guess the neutral is (about opposite center of main pole face). Move pencils back and forth from this point until you find point of lowest reading. Center brushes on this point, then recheck. This method is easier but not as accurate as the following method.

2. *Inductive kick method.* Here the generator must be at standstill with all brushes raised except one of each polarity. Bevel these two brushes, Fig. 5, to make line contact with commutator parallel to bars and at center of normal brush face. Connect these two brushes to a multi-scale low-reading voltmeter. Energize shunt field from a separate source of dc through quick-break knife switch.

Mark down peak voltmeter kick on each opening of field circuit. Shift brushes until you hit the spot giving smallest kick of needle. Rotate armature and repeat step several times. Note the neutral point you get each time. Mid-point of these marks is the exact neutral.

This is by far the preferred method. Incidentally, remember to include the field discharge resistor. You can have the resistor in the circuit at all times or just when the switch opens its contacts. It'll prevent insulation puncture.

INTERPOLE adjustment by the "buck and boost method"

Faulty interpole adjustment can also cause sparking. The "buck and boost" method tells if interpoles need adjustment. For this test connect a dc welder or some other controllable dc source in parallel with interpoles. Use a reversing switch with an ammeter in the circuit.

Let generator carry normal steady load with reversing switch closed in position to aid interpole. Assume brushes are sparking. Raise current through interpole until you note a change in commutation. If sparking increases, interpole is too strong. Reduce current to zero and reverse switch position to buck normal interpole current. Raise current again until sparking stops. Note ammeter reading. Continue to raise current until sparking starts. Take another ammeter reading. Difference between the two readings is *width of the black band.* Average of these two readings is amount of current that must be shunted around interpoles with a suitable resistor.

Weak Interpoles. If you find interpoles too weak, add shims between interpole cores and field frame. Use magnetic material for shims. Recheck after commutating pole gap is changed.

Formula for interpole gap shimming is:

$$\text{New gap} = \text{old gap} \div \left(1 \pm \frac{5 \times \text{amp boost or buck}}{\text{armature amp}}\right)$$

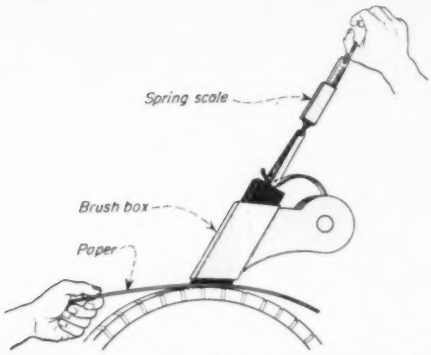
Use + for boost amperes

Use − for buck amperes

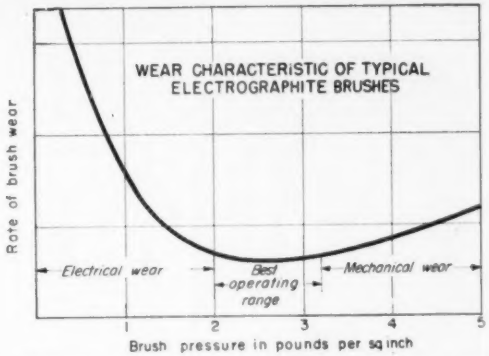
Factor 5 varies between 4 and 6 for wide range of machine designs. Use 5 to get good average results.

Contact Drop Method. Measurement of contact drop at the brush face is another way to determine interpole

SPRING TENSION AN IMPORTANT ANGLE IN DETERMINING THE WORKING LIFE SPAN OF BRUSHES



8 Hook spring-scale behind brush and take reading when paper slides. Adjust for about 2½ lb per sq in. of brush surface



9 Don't guess about brush pressures. You'll save brush and commutator wear and cut sparking with proper brush tension

adjustment. To do this connect one terminal of a low-reading voltmeter to shunt of one brush and other terminal to a hard-lead pencil, Fig. 6. Let pencil touch commutator at leading edge of brush, at ¼, midpoint, and ¾ width of brush. Then touch at trailing edge of brush. Typical voltmeter readings at each point are shown in Fig. 7.

If curve resembles A in Fig. 7, it shows the interpole is too strong. Curve *B* shows weak interpoles. Correct interpole adjustment is shown by curve *C*.

Generally if contact drop is over three volts, sparking results. So while a drop of at least one volt is necessary to control voltage in armature coil short-circuited by brush, a contact drop that is too high (three volts or higher) will in itself be a source of commutation trouble. It may show up by heavy sparking.

SMOKE and gases affect commutation

Atmospheric conditions can also affect commutation. You know the effect of acid fumes, chlorine, and other corrosive gases on electrical rotating machinery. But you'd never suspect tobacco smoke! Actually one or two puffs of cigarette smoke on a commutator will double the friction for several minutes. This is not because of high humidity, since simply blowing on commutator has no effect. And smoke from other sources is just as harmful, or even more so.

Here's another striking example of "contact poisons." A little carbon tetrachloride was used to clean some apparatus on the other side of a large, ventilated laboratory room. There was a commutator machine in the room. On a certain test the coefficient of friction between brushes and commutator had been practically constant for three days with a minimum of .09 and a maximum of .11. Within five minutes after the carbon tetrachloride was used friction doubled to about .25.

Ten minutes later the commutator, which formerly had a brown mirror polish, began to show raw copper streaks. Likewise, the brush faces which were smooth, slightly porous, polished surfaces, became grooved and roughened and showed pronounced copper picking. Six hours after the CCL_4 was used the poor commutator condition had not yet disappeared. And rate of brush wear during this 6-hour period was twice that of the average rate during preceding three days. Using carbon tetrachloride for cleaning electrical equipment may be affecting your commutator performance.

Current Density. Another common cause of threading and grooving, especially on high-speed exciters, is low-current density at brush contact on commutator. Quite often, a standard exciter is used that's 15 to 25% larger than needed.

The present-day electrographitic carbon brush has been developed for continuous operation at 70 to 80 amp per square inch. When this material is operated below 40 or 50 amp per square-inch density, it is common to have threading or fine bright grooves develop in the commutator film. Only remedy is to lift some of the brushes. Select them either all in one track or staggered around so the whole commutator surface is left as evenly covered as possible with brushes carrying between 60 and 80 amp per square inch. Brush density is calculated as:

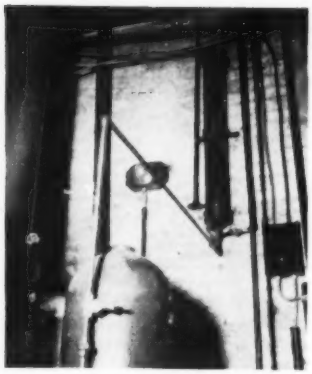
Amp per square inch =
(amperes in armature x 2) ÷
(No. brush arms × No. brushers per arm × brush width × brush thickness)

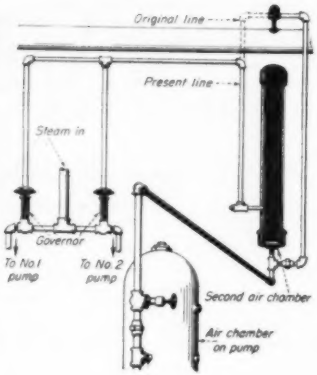
Brush Impact. Impacts from brush vibration on high-speed commutators cause a surface film on the commutator. This film of work-hardened or amorphous copper is even more susceptible to chemical attack than ordinary copper. The condition can be spotted readily by using sandpaper on the commutator. Note that amorphous copper, which can only be present on portion of commutator that passes under brushes, has a marked resistance to scratches or cutting by the sandpaper. Solution is to eliminate vibration and remove glaze with a commutator stone.

For best brush performance follow brush manufacturer's advice, or the machine builders' recommendations on brush pressure. Check each brush pressure with a small spring scale, Fig. 8. For commutating machines this pressure should be about 2½ to 3 lb per sq in. of brush contact surface.

Many plant men feel this business of brush pressures can be satisfied by simply checking the tension by feel. Sure, this will pick out very bad ones—those with spring tension very weak or much too strong—but you need a spring scale for a real job. And keep track of your readings. Thus, you establish your own recheck schedule.

PRACTICAL IDEAS...*here's the trading post for your*





NEW AIR CHAMBER GAGS NOISE

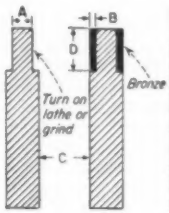
OUR HOTEL HAS two domestic-water, steam duplex pumps. They have the usual large cast-iron air chamber, but the discharge lines vibrated badly anyway. Then the sudden fluctuating pressure would transfer back to the governors, which opened and closed the steam supply so the pumps always worked erratically, especially when there was a large demand for water.

Even draining out the air chamber and charging with air did not stop the vibrating lines. Finally, I hooked up a small air chamber on the wall, as shown. This helped some, but not enough to prevent pumps being heard.

I made a simple change by running a $\frac{3}{4}$-in. line from pump governors to bottom of the second air chamber, instead of to the pumps' discharge line, as dotted lines in sketch show.

In this way, air in the small air chamber absorbs pulsations in the discharge line. Because the pulsation is dampened, it's not transferred to the pump governor. Governor in turn does not close in quickly or open up quickly on the steam supply. Result is two smooth-running duplex pumps. Pulsations are not heard or felt anywhere in our large hotel building now.

J W KERLIN *Trenton, N. J.*



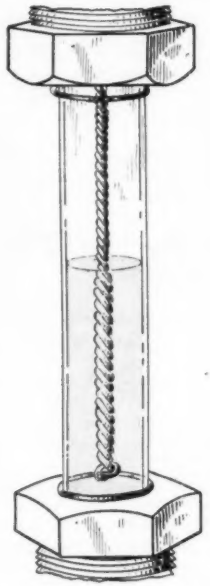
Dia - C, in.	Dia - A, in.	Length D, in.	Thickness B
¼	3/16	¾	1/16
5/16 to 3/8	¼ and 5/16	¾	1/16
7/16	3/8	1	1/16
½	3/8	1	1/8
5/8	½	1½	1/8
¾	5/8	1½	1/8
7/8	¾	2	1/8
1	1 3/16	2	3/16

SAFE HAND-CHISEL HEADS

TO INCREASE USEFUL LIFE and prevent "lipping" over and burring of hand chisel or punch head, I make safety heads.

Turn or grind tool head to measurements in table. Then fill in with bronze as in sketch. Tools already "lipped" over or burred may be made safe and useful by this method. With high cost of chisels, you will find this operation pays in safety and upkeep.

D J PARMER *Quincy, Fla.*



Braided String Is Water Column Aid

WATER GLASSES and columns on boilers or auxiliary equipment, such as heaters or hot wells, are often located so they are hard to view.

One way to make liquid level easier to detect is shown in sketch. This works where glass is viewed from about the same position at all times. A string or heavy twine is either braided or twisted, and is then fastened directly behind the glass.

Water acting as a lens causes the string to magnify about double the normal size. Colored string is better than white. This trick is very helpful if glass has a constantly changing water level.

A W SHEPHERD *San Diego, Calif.*

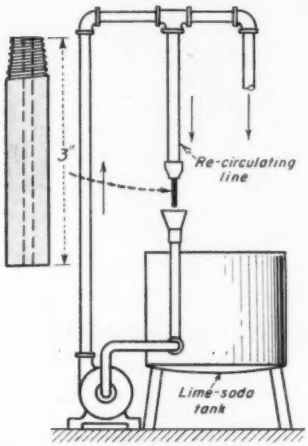
Make Close Nipple

WHEN STUCK FOR a close nipple, here's how I make one. Cut size of nipple to be used from length of threaded pipe. Screw threaded end ¼ to 1½ in. into nipple chuck. Remove guide from pipe threader, and insert next-largest-size guide that fits snugly over coupling on nipple chuck. This is an old trick.

C MITTENDORF *Brooklyn, N. Y.*

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*



Hardened Nozzle Outwears Valves

When our 120,000-lb-per-hr lime-soda softener was installed an all-iron gate valve controlled recirculation of the lime-soda solution. After two months valve fell apart from corrosion and abrasion in solution. We tried all-iron plugcocks, all-iron globe valves with stainless-steel disks and seats, and bronze and brass valves of all kinds. But nothing lasted more than a month or two. Besides the expense, we had to be adjusting continually for correct flow.

We then tried a plain cast-iron pipe plug, drilled (after experimenting) with a 3/32-in. hole. This lasted about six months. Then we made a tool-steel nozzle, as shown. It was hardened after machining.

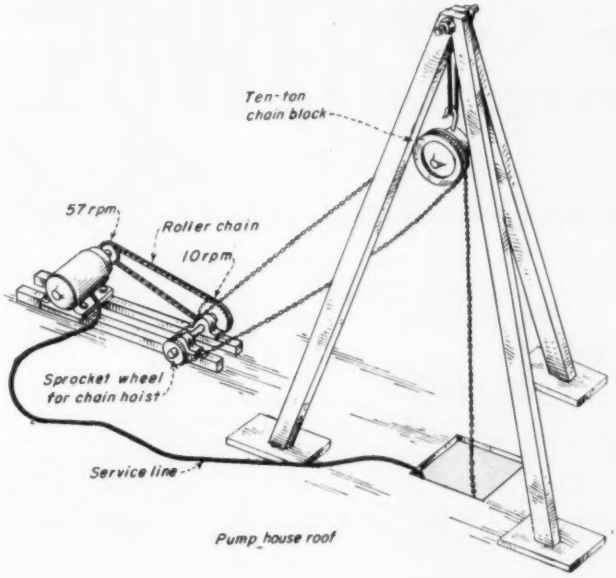
Nozzle has been in two years with no apparent wear. At times we poke a wire up to free a slight blockage that may occur. Strangely enough, we found that this 3-in.-long nozzle does not block as often as a shorter one.

K Shepherd *Hamilton, Ont.*

Feeding Coal by Hand

When a feed screw breaks, I keep the boiler in operation by feeding coal into the furnace by hand, with the fan in operation. Of course, the fire must be broken up often. I do this for a number of days or until I have time to replace the screw. Outage is unnecessary.

H A Jahnke *Milwaukee, Wis.*



MOTORIZED CHAIN BLOCK SPEEDS PUMP JOB

Our No. 1 well pump needed a complete overhaul. Cranes cannot reach the pump house, so we started the job by pulling up the pump from a tripod of heavy timbers with a 10-ton chain block. It took five men one hour of heaving on the hand chain to raise the 280 ft of 8-in. pipe, shafting and heavy pump, a distance of 20 ft. That convinced us there must be an easier way.

A scrounging trip around the plant turned up a 57-rpm 3-hp gear-head motor from an old conveyor. We also found a chain block and a variety of sprockets, etc. We lagged the motor to two pieces of 8x8-in. timber. Two bearings were fastened to the same timbers to carry a shaft that was parallel to the motor.

A sprocket at one shaft end, and a roller chain to line up to a smaller sprocket on the motor, reduced shaft's speed to about 10 rpm. We mounted a discarded plate-type sprocket wheel on the shaft's other end. The sprocket wheel from an old chain block was pinned to it. This rig was set up on the pump-house roof. A temporary service line was run to the motor. This is shown in the sketch above.

This outfit worked perfectly. Motor drove large chain block steadily, better than could be done by hand. While one man kept an eye on the lifting, the rest of crew went ahead with dismantling and repairing sections already raised. They lent a hand, when necessary, to uncouple and remove each 20-ft shafting section.

Where it had taken 55 minutes for five men to raise the first section, the motorized rig enabled us to remove a section in 35 minutes. Besides, the four men spent 30 minutes on actual repairs during each lift.

This rig eliminated back-breaking work. Overhaul time was cut in half. It also saved additional city power, which had been purchased during the down-time of our No. 1 well.

C E Littler *St. Vital, Manitoba*

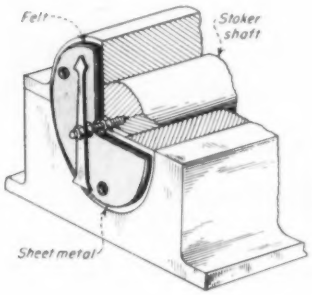
Shaft Indicator For Stoker Drive

On our chain-grate stokers, travel is geared down to a slow movement. To enable boiler-room operator to tell at a glance if grates are moving, we in-

Begins on page 126

stalled an indicator on drive shaft. Because of noise in boiler room, a sheared pin had been undetected until operator checked his fires, or noticed a pressure drop on header. We decided to prevent that from happening again.

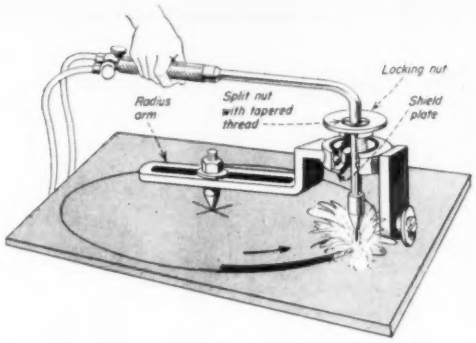
Here's how indicator in sketch is made. We cut a piece of felt to cover the bearing's end; also, a piece of sheet metal to cover the felt. We drilled 3 holes through sheet-metal cover and through felt for ¼-in. bolts. Also, we drilled center of sheet metal and of felt for ¼-in. screw as illustrated.



Next, we drilled and tapped 3¼x20 holes around bearing cap. Center hole of drive shaft was drilled and tapped for ¼ 20-in. screw. Then we bolted sheet-metal cover to bearing cap with felt on inside, to keep dirt out. We screwed ¼-in. bolt in center, installed an arrow, secured with nuts on each side of it.

Arrow is 6 in. long, and moves with the drive shaft. When the arrow stops, the boiler-room operator knows that something must be wrong.

A ROCKLIN *Chicago, Ill.*



SIMPLE GUIDE FOR FLAME-CUTTING CIRCLES

CUTTING CIRCLES NEATLY from steel plate reduces finish machining needed. Cut left by oxyacetylene flame is smooth enough without finish if you use some form of radius-controlling device to guide torch in circular path.

Circle cutting jig presets distance of torch nozzle from work surface. Operator can feed torch at constant rate. A circle-cutting device is easier to use if it can be controlled from one side of the work. Then operator need not change his position.

You can make device in sketch from odds and ends. Main item is an old ball race with a deep groove, about 2 in. diameter at outer race. Use an adapter for securing torch to inner ball race, turned from mild steel and threaded with pipe threading die for a taper thread.

Threaded portion is split by four saw cuts. Then screw a locking nut on taper thread so bore of adapter closes on torch and grips it firmly. Adapter has shield plate to prevent flame from damaging balls in race.

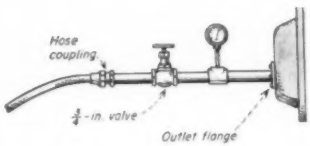
Have a hardened center point for placing in a deep punch mark at center of scribed circle. Nut at its upper end adjusts along slotted radius arm. Radius arm is bent from flat steel and welded to one side of ball race.

Weld a second piece of flat steel bar to opposite side of the ball race. On it mount a freely revolving wheel, which makes point contact with surface of steel plate being cut.

When using this guide, operator can stand in one spot and feed torch in a circle, by hand. As it travels around circle, inner and outer tracks of ball race rotate in relation to each other. That gives a freely swiveling joint between torch and circle-cutting guide.

Nozzle's distance from work surface can be adjusted with adapter. This can be locked and unlocked for setting the torch vertically for right height.

F E RILEY *London, England*



Testing Evaporator Coils

WHEN EVAPORATOR COILS are tested for leaks, tube assembly is usually left inside shell. Then tubes are filled with water and leaks detected by observation. With this method, tubes have to be pulled out, repaired, pushed back into shell; then shell is buttoned up and tested again. If tubes still leak, the same time-taking procedure is repeated.

Here's a simpler method: First pull tubes. Place a blind flange on steam inlet and one on steam outlet. On outlet flange, sketch, drill a hole and tap for ¾-in. pipe. Connect a gage to this flange, then valve, and hose coupling. Attach water hose, fill tubes with water to find leaks. Empty tubes through same hose into a sewer. Repair leaky tubes and run another test. When tubes are filled with water, leave off top flange on steam inlet until water comes to top. Then bolt on flange. This eliminates air pockets.

After all leaks are repaired, fill tubes with water until a reasonable pressure is shown on pressure gage. Then close valve. Note gage pressure, and leave water in tubes overnight. Note pressure next day. If there's no loss in pressures, you can be sure job is tight.

G J TROSKE *Midland, Mich.*

(*Continued on page* 130)

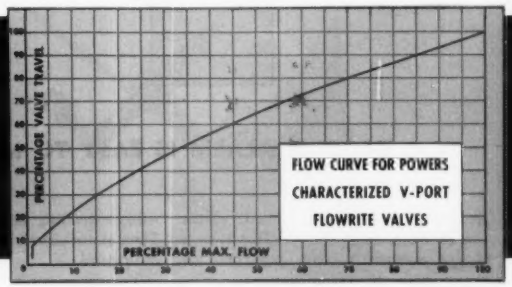
1
2
Special Cast Iron Housing and Top Only 4 Bolts
Compressed Air or Water Operated
BALL CHECK LUBRICATOR SILICONE grease for temperatures from 40° to 500° F.
Max. Pressure 250 psi.
Max. Temperature 450° F.
SIZES: ½" thru 2"
Direct and Reverse Acting

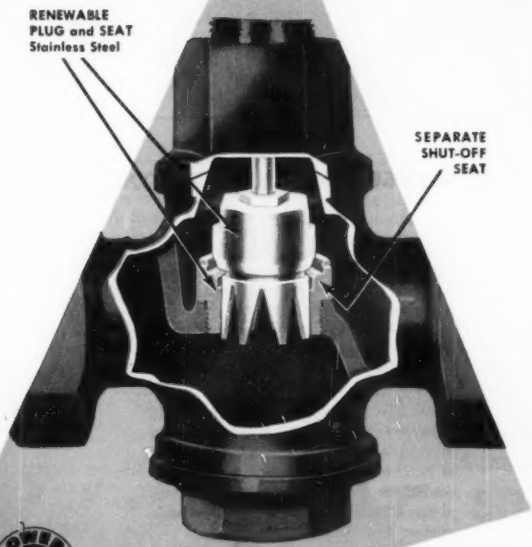
VALVE TOP—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment. Maximum air pressure in top, 22 psi.

POWERS® SINGLE SEAT V-PORT *Characterized* FLOWRITE VALVES Give—

Special Flow Characteristics—High lift V-Port plug provides proportional flow throughout entire lift of stem as shown in chart below.

Wide Variety of Valve Sizes—Nine sizes are available, ½" thru 2". The ½" valve can be furnished with plugs to give 15%, 30%, 60% or 100% of maximum capacity. Plugs are easily interchangeable without removing valve from line.





Better Control—Less Maintenance—Superior design of stainless steel plug and seat reduces wire drawing, insures longer life and tight shut off. V-Ports do the throttling, protecting separate shut off seat. Plug and seat are truly removable and can be easily replaced in the field. Inner valves are machined and precision ground and lapped within very close tolerances.

Low Hysteresis—Due to smooth rolling diaphragm and polished stainless steel stem in preformed lubricated packing.

Easy to Adjust—Ball bearing adjusting screw; rust proofed steel calibrated springs with full travel in 5 or 10 psi.

Easy to Install—Powers Flowrite V-Port valves have double unions and bronze body with rugged construction to withstand piping strains.

Easy to Service—Valve and top are easy to take apart and re-assemble, facilitating inspection and maintenance.

Reasonably priced. Contact our nearest office for prices and assistance in selecting proper size valves

THE POWERS REGULATOR CO.

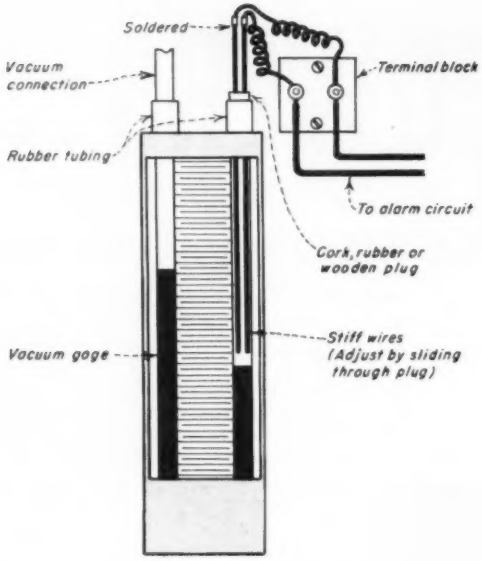
SKOKIE, ILLINOIS • Offices in Over 50 Cities

Chicago 13, Ill., 3819 N. Ashland Ave. • New York 17, N. Y., 231 E. 46th Street
Los Angeles 5, Cal., 1808 West 8th Street • Toronto, Ontario, 195 Spadina Ave.
Mexico, D. F., Apartado 63 Bis. • Honolulu 3, H. I., P. O. 2755—450 Piikoi at Kona

OVER 60 YEARS OF TEMPERATURE AND HUMIDITY CONTROL

(a70)

Begins on page 126



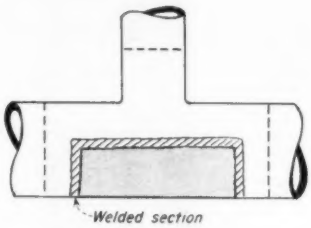
VACUUM ALARM IS EASY TO MAKE

A SIMPLE, sure-fire, low-vacuum alarm can be made as in sketch. Just take a U-type mercury vacuum gage and arrange with electrical contacts. Also other parts shown.

When vacuum drops, mercury rises on one side until it contacts the two stiff wires extending into that leg of gage. Then alarm circuit closes and a warning is sounded.

This alarm can be set for any drop in vacuum by adjusting the stiff wires in the gage to any desired depth.

T TRAIL *Catonsville, Md.*



Handy Pipe Repair

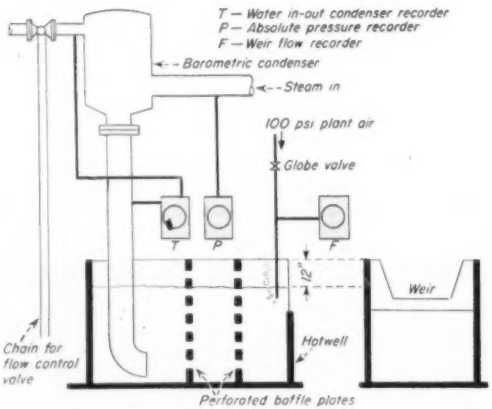
OUR DRAINS from soot blowers, water columns and feedwater regulator flow into blowdown line. This line is of extra-heavy pipe, but condensate, water and steam under high pressure wear a hole at bottom of tee. This repair came up pretty often.

We used to cut this section of pipe in three places, shown by dotted lines in sketch. Then we had to weld in a new tee. But that often gave trouble in lining up the work, as well as other headaches. Location of line made lining up tough.

Now we cut a piece out of bottom and weld in a patch as shown. This is done by splitting a section of extra-heavy pipe of same size and cutting it to fit. Then when this section wears again, we cut it out and replace it. That saves a complicated operation.

This method can be applied to other services where pitting and corrosion are a problem. It sure saves us time.

A ROCKLIN *Chicago, Ill.*



CONDENSER INSTRUMENT STORY

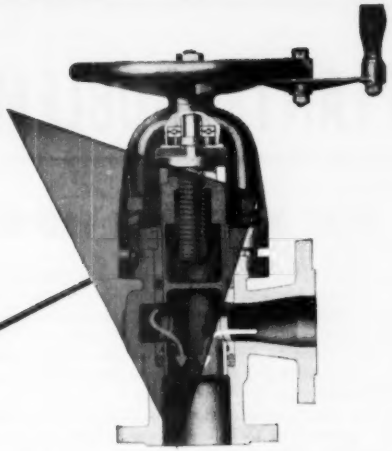
THE SKETCH shows instruments for a newly installed barometric condenser. These instruments not only help check on guaranteed performance, but also enable operators to obtain optimum water-pumping rates.

In addition, they show continuously the effectiveness of air-removal equipment. Total installed cost was $700. Flowmeter uses air to force water out of a ¼-in. pipe (bottom of pipe is set at bottom of weir) and pressure is recorded as inches of water. A curve, plotting height of water on the weir against flow, is used to obtain flow.

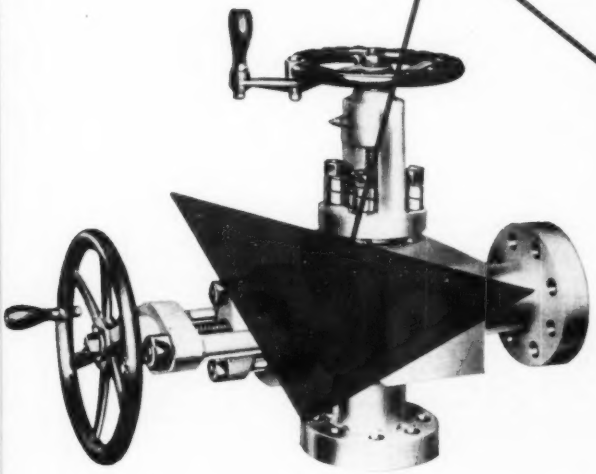
M EVANS *Chicago, Ill.*

OVER 15,000 BOILER PLANTS USE THESE BLOW-OFF VALVES

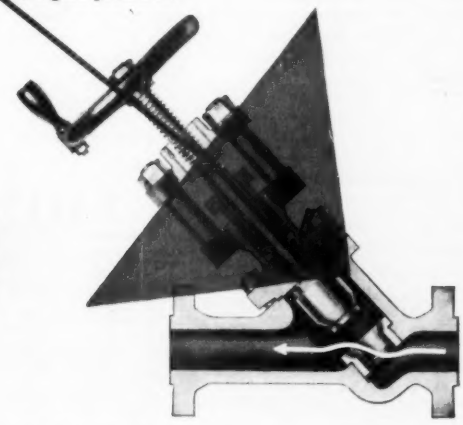
MADE FOR EVERY PRESSURE



This is the famous Yarway *Seatless* Blow-Off Valve. Balanced, sliding, nitralloy plunger design eliminates seat—a common source of wear, clogging and leaking. Type B (above) for pressures 50 to 400 psi, angle or straightway, single or tandem. Other types available for higher pressures. Complete description and specifications in Bulletin B-424 for pressures to 400 psi, or Bulletin B-433 for higher pressures.



The Unit Tandem—Yarway's finest blow-off valve for high pressure service. Combines a Hard Seat Valve (for blowing) and a Seatless Valve (for sealing) in a one-piece forged-steel body, flanged or socket welding ends. Also available combining two hard-seat valves. For pressures to 2500 psi. See Bulletin B-433.



This is Yarway's Stellite-Seat Valve for pressures to 2500 psi. Shown here in open position. Disc and seat ring are stellite-faced and carefully mated for tight seating, long life and hard wear. Angle or straightway, single or tandem combinations (hard seat—hard seat or hard seat—seatless) available. Complete specifications and description in Yarway Bulletin B-433.

YARNALL-WARING COMPANY • 100 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

STEAM PLANT EQUIPMENT

PLANT PROBLEMS... *put your know-how to work*

WHAT MAKES BEST PROCESS-PLANT LOG?

HERE ARE THE FACTS: I've been hired as chief of a new industrial power plant that will go on the line soon. It has a large process-steam load, moderate electric-power demand, refrigeration, air-conditioning, heating and pumping loads.

About 20 men will run the plant and I've been busy trying to work up good log sheets for our turbines, boilers, refrigeration and other units.

Have *Power* readers any ideas that will help me? I'd like to see samples of their log sheets to help plan mine.—*TK.* Jan *Power*

Here Are the Answers

HEATING PLANT, No. 1 below, is what we came up with after several trials. It gives a number of hourly running facts we check against meters. The log is printed on high-quality white ledger paper for permanency and filed in a ledger binder. Sheet has extra spaces at the bottom for calculations and tabulations.

Don't have more than 500 copies printed at one time. As you add new plant units or change the production cycle you may wish to change entry headings. Leave several columns blank on new logs so you can add readings you may have overlooked. Don't depend too much on log readings when making an efficiency check. Recording instruments are much more dependable.

Be especially careful when placing equipment on the line the first time. If you make a complete record of all operating data you'll have a valuable reference for future work.

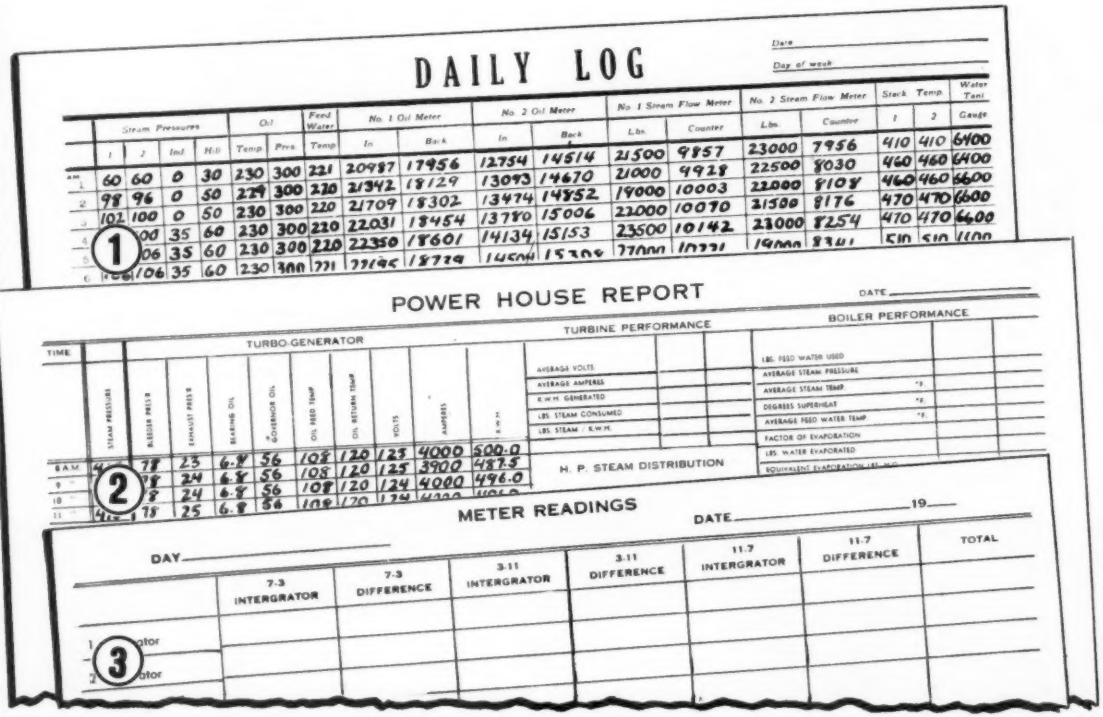
To schedule our maintenance we take time readings for individual boiler units from our main control panel. These readings show actual running time of each boiler. Besides giving us a line on maintenance they are also good for checking steam output each month of the heating season.

L. W. FITZPATRICK
Jefferson City, Mo.

METAL-WORKING PLANT log, No. 2, is shown below. In this plant we purchase ac and generate dc current.

ART CANNON
Laurence Harbor, N.J.

IT'S CUT AND TRY. The log sheets I made up for my plant, No. 3, 9 and 11, have worked well. I tackled the problem by cut and try. I wrote down all the readings I could think of for boilers, turbines and generators. Then I looked



DAILY LOG

Date
Day of week

	Steam Pressures				Oil		Feed Water	No. 1 Oil Meter		No. 2 Oil Meter		No. 1 Steam Flow Meter		No. 2 Steam Flow Meter		Stack Temp.		Water Tank
	1	2	Ind.	Hdr.	Temp.	Pres.	Temp.	In	Back	In	Back	Lbs.	Counter	Lbs.	Counter	1	2	Gauge
AM 1	60	60	0	30	230	300	221	20987	17956	12754	14514	21500	9857	23000	7956	410	410	6400
2	98	96	0	50	229	300	220	21342	18129	13093	14670	21000	9928	22500	8030	460	460	6400
3	102	100	0	50	230	300	220	21709	18302	13474	14852	19000	10003	22000	8108	460	460	6600
4	102	100	35	60	230	300	220	22031	18454	13790	15006	23000	10070	21500	8176	470	470	6600
5	102	106	35	60	230	300	220	22350	18601	14134	15153	23500	10142	23000	8254	470	470	6600
6	102	106	35	60	230	300	221	22645	18739	14504	15309	22000	10221	19000	8341	510	510	6400

(1)

POWER HOUSE REPORT

DATE

TIME	TURBO-GENERATOR										TURBINE PERFORMANCE			BOILER PERFORMANCE		
	STEAM PRESSURE	BLEEDER PRESS.	EXHAUST PRESS.	BEARING OIL	GOVERNOR OIL	OIL FEED TEMP.	OIL RETURN TEMP.	VOLTS	AMPERES	K.W.H.	AVERAGE VOLTS			LBS. FEED WATER USED		
8 A.M.	400	18	23	6.8	56	108	120	123	4000	500.0	AVERAGE AMPERES			AVERAGE STEAM PRESSURE		
9 "	400	18	24	6.8	56	108	120	125	3900	487.5	K.W.H. GENERATED			AVERAGE STEAM TEMP.	°F	
10 "	400	18	24	6.8	56	108	120	124	4000	496.0	LBS. STEAM CONSUMED			DEGREES SUPERHEAT	°F	
11 "	400	18	25	6.8	56	108	120	124	4000	496.0	LBS. STEAM : K.W.H.			AVERAGE FEED WATER TEMP.	°F	
														FACTOR OF EVAPORATION		
											H. P. STEAM DISTRIBUTION			LBS. WATER EVAPORATED		
														EQUIVALENT EVAPORATION LBS. H2O		

(2)

METER READINGS

DATE 19

DAY

	7-3 INTERGRATOR	7-3 DIFFERENCE	3-11 INTERGRATOR	3-11 DIFFERENCE	11-7 INTERGRATOR	11-7 DIFFERENCE	TOTAL
1 ...tor							
2 ...tor							

(3)

help the other guy cure his headaches

TYLER HICKS, *Associate Editor*

BASEMENT LOG SHEET

DATE _____

TIME SHIFT A.M. P.M.	HEATING SYSTEM: RETURN TEMP.	HEATING SYSTEM: DISCH. PRESS.	DOMESTIC HOT WATER: TEMP. OUT	DOMESTIC HOT WATER: PRESSURE IN	DOMESTIC HOT WATER: PRESSURE OUT	OIL TO FIRE PUMP PINTS: H.P.	OIL TO FIRE PUMP PINTS: L.P.	TIME A.M. P.M.	FIRE PUMP: WATER: INTEGRATOR REV RDG.	FIRE PUMP: WATER: REVS.	FIRE PUMP: WATER: DISCH. PRESS.	FIRE PUMP: CONDENSATE: COUNTER READING	FIRE PUMP: CONDENSATE: DIFFERENCE	FIRE PUMP: CONDENSATE: VAC.	CONDENSER PUMP DISCHARGE PRESSURE: Time	1	2	3
12								12										
1								4										
2								8										

(4)

No. 1 and No. 2 Compressors Performance Data

DATE _____

TIME SHIFT A.M. P.M.	No. 1 COMPRESSOR: REV. INDICATOR: Cond.	REV. INDICATOR: N. Cond.	R.P.M. AVG.	PRESSURES: STEAM: Rec.	STEAM: Boost.	AIR: Inter-cooler	AIR: High	Cooling Water Temp.: Inlet	L.P. Jacket Out	H.P. Jacket Out	Inter-cooler Out	After cooler Out	Air Temp.: Inter-cooler Out	After Cooler Out	TIME A.M. P.M.	No. 2 COMPRESSOR: REV. INDICATOR	R.P.M. AVG.	PRESSURES: STEAM: Rec.	STEAM: Boost.	AIR: Inter-cooler	AIR: High	COOLING WATER TEMP.: L.P. Jacket Out	H.P. Jacket Out	Inter-cooler Out	Air Inter-cooler Out
12 MN.															12 MN.										
2															2										
4															4										

(5)

Sheet No. _____ DAILY PLANT REPORT Date _____

A/C. ELECTRIC ENERGY PURCHASED

Quebec Hydro Meters	Sun Life Meters
Quebec Hydro Line in Service	
Max. Demand _____ kws.	Max.Demand _____ kws.
Power Factor W.h.m.#1 _____ #2 _____ Ratio _____	Total Energy W.h.m. _____ kws.
Main Station W.h.m.#1 _____ #2 _____ Total _____	Main Station P. _____ L. _____ Total _____
Gen.Room Feeder W.h.m.#1 _____ #2 _____ Total _____	Gen.Room Feeder P. _____ L. _____ Total _____
LOAD FACTOR %	POWER FACTOR %

D.C. ELECTRIC ENERGY PRODUCED

Motor Generators	No.1 _____	No.2 _____	No.3 _____	Total _____ kws.	Battery Service
Rectifiers	No.1 _____	No.2 _____		Total _____	Service _____ kws. Charged _____ hrs.
Turbo	on _____	off _____		Total _____	Emergency _____ " " _____ "
					Signal _____ " " _____ "

(6)

EQUIPMENT IN SERVICE

Operating Equipment

Air Compressors	R.H.S. Circulating Pumps	Compressors in Service	Brine Pumps in Service
Sewage & General Service	A1 Steam on off	No. for hrs.	No. for hrs.
No.1 on off	A2 " " "	No. " "	No. " "
No.2 " "	B1 " " "	No. " "	No. " "
No.3 " "	B2 " " "	Ammonia Pressure	Temperature of Brine System
Elevator Service	C a/c M. " "	High lbs. Low lbs.	L.L. L.T. °F Max. °F Min.
No.1 on off	D " " "	Circ.Water Temperature	L.L. H.T. " " " "
No.2 "	E " " "	In. °F Out °F	H.L. H.T. " " " "
Thermostat Service	F " " "	Power Factor %	H.L. L.T. " " " "
	Emergency Pumps	Drinking Pumps in Service	Cold Water
		No. for hrs.	Room Temperatures 1st Base.

(7)

For "Your New Problems" turn to page 136

More LOGS on page 134

at the list from two angles: making it as simple as possible, keeping cost down.

Enter all readings for one section of the plant on a separate sheet. Don't have boiler-room readings on the turbine log. Avoid duplication; it wastes operator's time. Make a separate log for meter readings. It saves time. Leave a space for remarks and the watch operator's signature on each sheet.

We bind our old logs and use them for records. They give a good check on plant efficiency and operation.

B D RILEY *Brunswick, Ga.*

OUR LOG SHEETS—one is No. 12—were laid out to be as simple as possible without neglecting important readings. We don't keep a boiler-room log because instruments fully cover our readings. All we do is weigh coal and issue a

(*Continued on page 212*)

TURBINE ROOM DAILY LOG

DATE _____

TIME SHIFT	ELECTRIC LOAD DISTRIBUTION — KW: A.C. TOTAL GEN	TO BOILER ROOM AUX	NET GEN	TEST FLOOR No. 1	TEST FLOOR No. 2	TO ALL SHOPS	A.C. TO NORTH SHOP	W.E.P. TO SOUTH SHOP	FROM W.E.P.	TOTAL SHOPS NORTH	TOTAL SHOPS SOUTH	TOTAL PLANT LOAD	3200 KW — No. 1: LOAD KW	KWH INTEGRATOR COM.	KWH INTEGRATOR N CON	ABS. EXH PRESS MG	EXH TEMP °F	HOT WELL TEMP °F	CIRCULATING WATER °F IN	CIRCULATING WATER °F OUT	3200 KW — No. 2: LOAD KW	KWH INTEGRATOR CON	KWH INTEGRATOR N CON	ABS. EXH PRESS MG	EXH TEMP °F	HOT WELL TEMP °F	CIR. WATER OUT °F	1000 KW — No. 3: LOAD KW	KWH INTEGRATOR CON	KWH INTEGRATOR N CON	ABS. EXH PRESS MG	EXH TEMP °F	HOT WELL TEMP °F	CIR. WATER OUT °F
8																																	

TURBINE ROOM LOG SHEET

DAY _____ DATE _____ 19___ TURBINE NO. _____

FLOWS: THROT. P. LBS PER HR	SS BAT PER HR	TEMPERATURES: STEAM THROT	STEAM 150	STEAM 35	STEAM EXH HOOD	OIL LEAVING BEARINGS 1	2	3	4	5	OIL COOLER IN	OIL COOLER OUT	WATER OIL COOLER IN	WATER OIL COOLER OUT	CONDENSER IN	CONDENSER OUT	HOT WELL	VAC PUMP	FEED WAT	PROCESS 150	PROCESS 35	PRESSURES: STEAM THROT	STEAM 1ST EXH	STEAM 150	STEAM 35	HOT WELL FEED	FEED WAT IN	FEED WAT OUT	OIL FEED	OIL RELAY	VAC INS MER	BAR INS MER	COMP AIR	OIL TO SMT	BER WAT	REMARKS
9																																				
7 A. M.																																				

BOILER OPERATION REPORT

PERIOD ENDING _____

SHIFT	NAME

BOILER N

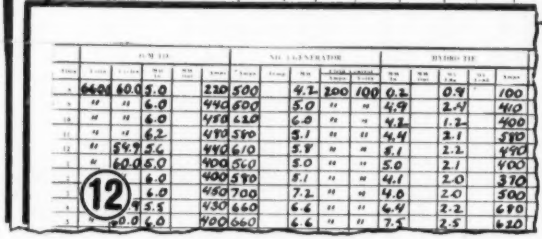
B. C.

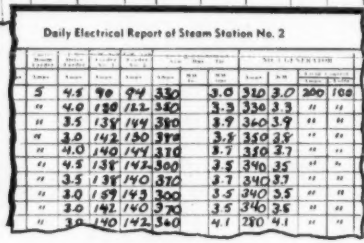
10	TIME	STEAM PRESS. LBS.	STEAM TEMP. °FAHR	STEAM FLOW THS. LBS. PER HR.	AIR FLOW THS. LBS. PER HR.	FEED WATER TEMP. °FAHR.	FLUE GAS TO HEATER TEMP. °FAHR.	FLUE GAS FROM HEATER TEMP. °FAHR.	AIR LEAVING HEATER °FAHR	SERVICE WATER PRESSURE	WIND BOX PRESS INCHES	FURNACE DRAFT INCHES	UPTAKE	AIR HEATER OUTLET INCHES	MOTOR AMP: INDUCED DRAFT FAN	MOTOR AMP: FORCED DRAFT FAN	BEARINGS INSPECTED OIL AND WATER	FEED WATER: No. 1 HEATER LEVEL	No. 1 HEATER TEMP	No. 2 HEATER LEVEL	No. 2 HEATER TEMP	No. 1 PUMP PRESS	No. 2 PUMP PRESS	No. 3 PUMP PRESS
	9 K	540	60	66	210	705	460	430	42		1.8	-0.1	-1.4	-2.9	93	54	✓	3/4	209					295
	10 K	540	60	66	210	710	455	420	42		2.2	-0.1	-1.4	-2.9	93	54	✓	"	209	"				290

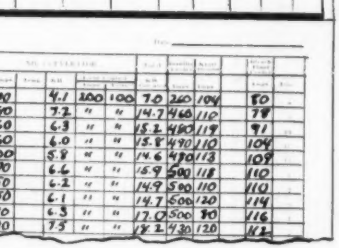
GENERATOR LOG SHEET

DAY _____ DATE _____ 19___

11	TIME	GENERATOR NO. 1: BUS VOLTS	BUS FRQ	KW	KVR	FIELD AMP	PHASE AMPERE A	PHASE AMPERE B	PHASE AMPERE C	GEN TEMP	EXCITER VOLTS	GENERATOR AIR COOLER IN	GENERATOR AIR COOLER OUT	GENERATOR NO. 2: KW	KVR	FIELD AMP	PHASE AMPERE A	PHASE AMPERE B	PHASE AMPERE C	GEN TEMP	EXCITER VOLTS	GENERATOR AIR COOLER IN	GENERATOR AIR COOLER OUT	GENERATOR NO. 3: KW	KVR	FIELD AMP	PHASE AMPERE A	PHASE AMPERE B	PHASE AMPERE C	GEN TEMP	EXCITER VOLTS	GENERATOR AIR COOLER IN	GENERATOR AIR COOLER OUT
	7																																
	8																																







Daily Electrical Report of Steam Station No. 2

12	Time	A.M. Load KW	A.M. Power Factor	A.M. Amperes	A.M. Volts	No. 1 Generator Load KW	No. 1 Generator Amperes	No. 1 Generator Volts	No. 1 Generator Power Factor	Bus Tie Load KW	Bus Tie Amperes	Bus Tie Volts	Bus Tie Power Factor	Time	No. 2 Generator Load KW	No. 2 Generator Amperes	No. 2 Generator Volts	No. 2 Generator Power Factor	Time	No. 3 Generator Load KW	No. 3 Generator Amperes	No. 3 Generator Volts	No. 3 Generator Power Factor	P.M. Load KW	P.M. Power Factor	P.M. Amperes	P.M. Volts
	1	660	60.0	5.0	230	500	4.7	200	100	0.2		0.9		100													
	3	"	"	6.0	440	600	5.0	"	"	4.9		2.4		410													
	5	"	"	6.0	450	630	6.0	"	"	4.8		1.2		400													
	7	"	"	6.2	490	580	5.1	"	"	4.4		2.1		380													
	9	"	59.9	5.6	440	610	5.8	"	"	5.1		2.2		440													
	11	"	60.0	6.0	400	560	5.0	"	"	5.0		2.1		400													
	1	"	"	6.0	400	590	8.1	"	"	4.1		2.0		370													
	3	"	"	6.0	450	700	7.2	"	"	4.8		2.0		500													
	5	"	59.5	6.0	430	660	6.6	"	"	4.4		2.2		680													
	7	"	60.0	6.0	400	660	6.6	"	"	7.5		2.5		620													

Daily Electrical Report of Steam Station No. 2

Time	A.M. Load KW	A.M. Power Factor	A.M. Amperes	A.M. Volts	No. 1 Generator Load KW	No. 1 Generator Amperes	No. 1 Generator Volts	No. 1 Generator Power Factor	Bus Tie Load KW	Bus Tie Amperes	Bus Tie Volts	Bus Tie Power Factor	Time	No. 2 Generator Load KW	No. 2 Generator Amperes	No. 2 Generator Volts	No. 2 Generator Power Factor	Time	No. 3 Generator Load KW	No. 3 Generator Amperes	No. 3 Generator Volts	No. 3 Generator Power Factor	P.M. Load KW	P.M. Power Factor	P.M. Amperes	P.M. Volts
5	4.5	90	94	330	3.0	330	3.0	200	100																	
"	4.0	130	132	380	3.3	330	3.3	"	"																	
"	3.5	138	144	380	3.9	360	3.9	"	"																	
"	3.0	142	150	398	3.3	350	2.9	"	"																	
"	4.0	140	144	310	3.7	350	3.7	"	"																	
"	4.5	138	142	300	3.5	340	3.5	"	"																	
"	3.5	138	140	370	3.7	340	3.7	"	"																	
"	3.0	139	143	300	3.5	340	3.5	"	"																	
"	3.0	142	140	370	3.5	340	3.5	"	"																	
"	3.0	140	142	360	4.1	280	4.1	"	"																	

Time	A.M. Load KW	A.M. Power Factor	A.M. Amperes	A.M. Volts	No. 1 Generator Load KW	No. 1 Generator Amperes	No. 1 Generator Volts	No. 1 Generator Power Factor	Bus Tie Load KW	Bus Tie Amperes	Bus Tie Volts	Bus Tie Power Factor	Time	No. 2 Generator Load KW	No. 2 Generator Amperes	No. 2 Generator Volts	No. 2 Generator Power Factor	Time	No. 3 Generator Load KW	No. 3 Generator Amperes	No. 3 Generator Volts	No. 3 Generator Power Factor	P.M. Load KW	P.M. Power Factor	P.M. Amperes	P.M. Volts
150	130	1.2		580	4.1	200	100	7.0	260	104		80														
200	200	1.7		750	7.2	"	"	14.7	460	110		78														
200	250	1.8		660	6.3	"	"	15.2	480	119		91														
212	280	2.0		660	6.0	"	"	15.8	490	110		104														
205	260	1.0		600	5.8	"	"	14.6	490	113		108														
200	290	1.4		700	6.6	"	"	16.9	500	118		110														
200	260	1.8		650	6.2	"	"	14.9	500	110		110														
205	250	2.0		650	6.1	"	"	14.7	500	120		114														
210	260	1.5		670	6.3	"	"	17.0	500	90		116														
215	280	0.4		690	7.5	"	"	18.2	490	120		112														

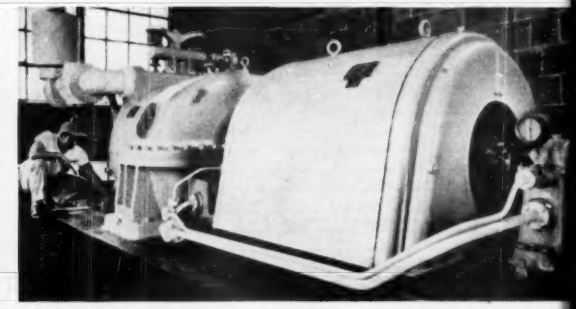
(Continued on page 136)

Begins on page 132

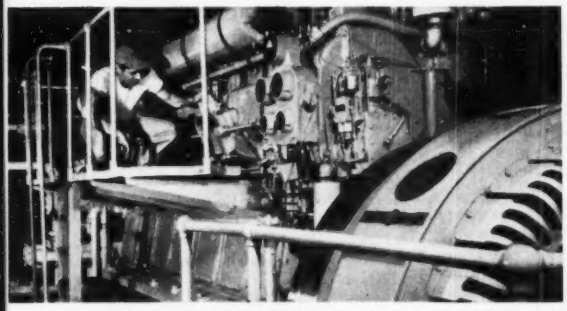
NANTUCKET ISLAND can't tie in with mainland power facilities and must therefore be entirely self-sufficient. To assure unfailing performance, the Nantucket Gas & Electric Company uses Sun lubricants exclusively. Also, engineers of the utility, of the diesel builders, and of Sun Oil cooperated to make possible a unique, three-way use of one inexpensive Sun fuel.

HOW SUN PROTECTS NANTUCKET'S POWER

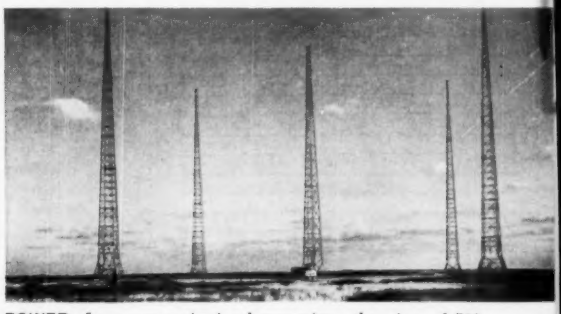
THE ISLAND'S POPULATION drops from around 16,000 to some 3,800 when the vacation season ends. With the power load fallen off so drastically, much of NG&E's equipment lies idle and subject to condensation during this extended time.



DESPITE IDLENESS for considerable periods, turbine journals, bearings and controls remain free at all times of sludge, rusting and corrosion—thanks to the protection of Sunvis 916. Its special metal-wetting additives displace any moisture that may be present.



A SUN DIESEL LUBRICANT has kept this 1,000-hp engine purring almost 15,000 hours. A single heavy, low-cost Sun fuel drives NG&E's diesel, fires its boilers, enriches its illuminating gas.



POWER for a new navigational transmitter, throwing a 1,700-mile beam for guiding aircraft, is supplied by Nantucket G&E—more evidence of the reliance placed on its Sun-lubricated plant.

For complete information about Sun's turbine and diesel oils, or for the services of a Sun representative, call the nearest Sun Office, or write to Dept. P6

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO

More PLANT PROBLEMS

Begins on page 132

BOILER HOUSE DATA SHEET (13)

METER READINGS	BLR NO	NIGHT 1:00	2:00	3:00
F.M.C. South Steam Flow				
1. Steam Flow	1			
Steam Flow	2			
Steam Flow	3	40778	40847	4095
2. Feed Wtr. Flow	1			
Feed Wtr. Flow	2			
Feed Wtr. Flow	3	75174	75265	753
3. Steam Pressure	1 2 3	150	150	150
4. CO	1 2 3	10	10	10
5. Flue Gas Temp.	1 2 3	625	620	625
6. Feed Wtr. Temp.		222	222	220
7. Out Temp. F		42	42	42
8. In Temp. F		80	82	87
9. Res. Temp. F		78		
10. Feed Pump	1 2 3	2	2	2
11. Water Softener	1	140071	140291	140
Water Softener	2	3	3	3
12. Make-up Water		434407	434716	434
13. Heating Steam		63180	63211	6323
14. Process Steam		20628	20669	2070
15. Air Pressure		94	90	92
16. Water Pressure		37	38	36
17. K.W. Meter	1	9374	9374	9374
K.W. Meter	2	7878	7879	787
18. Max. Demand		147	136	127
19. Coal Consumed	1			
Coal Consumed	2			
Coal Consumed	3			
20. Blow-down	1 2 3			

SUMMARY OF ECONOMIC RESULTS		C
21. Make-up %	12 ÷ 2 x 100	
22. Blow-down %	(21) ÷ 2 x 100	
23. Coal Consumed		
24. Actual Water Evaporated		
25. Factor of Evaporation		
26. Equiv. Water Evaporated	24 x 25	
27. Actual Evaporation	24 ÷ 23	
28. Equiv. Evaporation	26 ÷ 23	
29. Equiv. Eff. of Gen.	28 ÷ BTU 970.2	
30. Coal Cost		
31. Equiv. Cost per M Lbs.	30M ÷ (28 x Ton)	
32. Total Equiv. Cost	31 x 28 ÷ M	
33. B.H.P.	26 ÷ (34.5 x Days)	
34. Heating H.P.	(13 x 25) ÷ 829	
35. Process H.P.	(14 x 25) ÷ 970	
36. Rate %	33 ÷ 625 x 100	

	INSPEC
Boilers	
Feed Pumps	
Compressors	
Stokers	
Coal Conveyor	
Ash Conveyor	
Work Operations	163-165-166.76-399
Work Operations	346-151-153-399-45

FIREMAN C-SHIFT _____ FIRE ENGIN
ENGINEER
[redacted] C-SHIFT _____ [redacted]

WILL DIESEL CUT CREAMERY COSTS?

HERE ARE THE FACTS: Our small creamery has a 300-sq-ft hand-fired hrt boiler. Compressors and pumps are motor-driven. Maximum electric load is about 15 kw. Local power company supplies current.

We've been wondering if it would be more economical to install a diesel generating unit to handle our power and light loads. We'd also like to convert the hrt to burn diesel oil instead of coal. Electric bill now runs $200 per month, coal $100.

Is a diesel practical? Would we save enough to make the investment worthwhile? Can we burn diesel oil in the hrt?—*GG*, Jan *Power*

Here Are the Answers

IMMERSION HEATERS, the electric type, and electric boilers are widely used in small creameries because they successfully compete with hand-fired boilers when electric cost is low.

If *GG*'s power cost is too high for electric heaters or boilers, he should look into the savings possible with automatic combustion control when firing No. 2 and 3 oil. Oil cuts labor costs and can be burned at a higher efficiency.

Small diesel-generating units have advanced much in recent years. They run on No. 2 oil and generate 7.5 to 10.5 kwhr per gal. Cost of oil runs between 11.8 and 15.2¢ per gal. This gives a fuel cost of 1.12 to about 2¢ per kwhr. Lubrication runs 2 mills, and repairs, maintenance and supplies cost 2 to 12 mills per kwhr. Over-all cost would run 2.5 to 3.4¢ per kwhr, excluding depreciation and labor.

Use a 20-kw generating unit to han-

(*Continued on page* 212)

YOUR NEW PROBLEMS

1 Why Does Oil-Burner Pressure Fall Off?

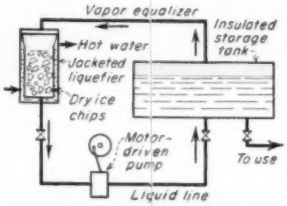
We burn No. 6 oil in a 3500-lb-per-hour A-type watertube boiler. Burners are mechanical-atomizing type. Load varies a great deal during the day.

Recently we've been bothered by excessive smoke coming from our stack. Burners are hand controlled and we have some trouble keeping fires and load balanced.

Oil return line at boiler is fitted with a ½-in. pop valve. Similar pop valves are on oil-pump discharge. All these valves relieve excess pressure in burner supply line.

When the oil is hot it appears to heat valve spring, changing the tension and allowing valve to open at too low a pressure. So pressure in burner line varies.

Is this variation the cause of smoke? Can heat from oil change spring tension? What's best and simplest way of stopping smoke in our plant?—*HP*



2 Why Does Our Pump Become Snowbound?

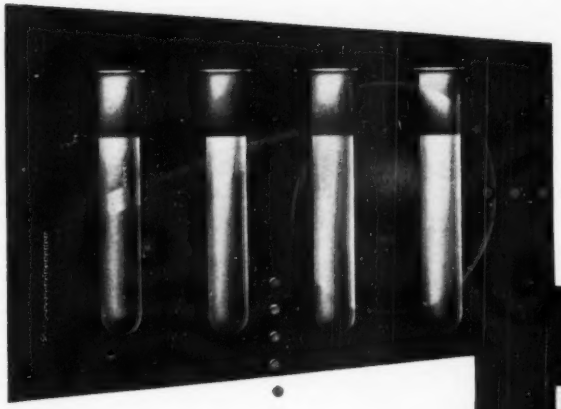
We salvage chips of dry ice in our plant by liquefying them in a hot-water jacketed tank. Motor-driven pump takes suction from bottom of tank and discharges into a horizontal insulated storage tank. See sketch.

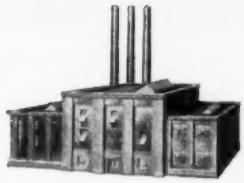
Carbon-dioxide vapor formed in storage tank vents to liquefier through overhead line.

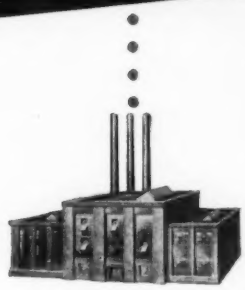
After we run pump about 5 min, suction line and cylinder become plugged with dry ice.

Why does dry ice form in suction? How can we prevent it? Can we run pump continuously without ice and vapor?—*TF*

Will you help readers who sent us their problems? Extra pay for photos, sketches.







Here's a sure way to control carryover and blowdown

Impure steam and excessive blowdown are two "bugaboos" that need not be tolerated by any power plant engineer, thanks to effective anti-foam agents.

Within recent years, the Betz organization has developed several anti-foam agents which have produced remarkable results both from a standpoint of better boiler operation as well as direct savings.

For instance, a large midwestern plant operated at 250 pounds pressure and used boiler feedwater softened by the hot lime soda process. The river water used as make-up at this plant varied widely in composition and was contaminated by a number of industrial wastes. Highly impure steam was produced with boiler water concentrations of approximately 3,000 ppm.

After analysis, Betz Engineers applied properly formulated anti-foam agents to this problem. Boiler water concentrations were raised to the extremely high value of 16,000 ppm before a similar steam impurity developed!

The positive control of carryover and boiler blowdown is only one of the many services extended by the Betz Organization. Let us explain to you how our *complete* engineering guidance can help you solve all your water problems. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal I.

For the complete story on carryover and blowdown control through the use of anti-foam agents, write for Technical Paper No. 115.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers

TEETOTALING EXPERIENCE WITH TEA

I WAS REMINDED by D B Clapp's item, "How to Plaster Pigeons" (p 126, Jan POWER), of a go-round with sparrows.

There were birds everywhere in that powerhouse—switchgear, oil tanks, rafters, nests in engine air intakes and building ventilators. Their "mud" was on log sheets and dining table.

We took care of our little tenants, but let's get on with the yarn. The best part of it involves our tea lover. He was a guy that, just about the time an extra hand was needed, would be very apologetic about not being available for a minute. "He was at his tea."

Well, we strung two #2 wires about 1 in. apart up near the skylight. Then we tied them into the 220-v system through fuzes and two 200-w bulbs, leaving the circuit open. Brother, when a sparrow stood on one wire and sharpened his bill on the other he literally "footed the bill."

But one thing about this hookup was that it ran right over our lunch table where the tin teapot always sat on the hot plate. It just so happened, too, that the lid was left open one afternoon. Our friend made his usual tea, enjoyed it, then emptied the dregs down the drain while a couple of the boys looked on. You guessed it, the menu had included a juicy, well-boiled sparrow.

K R MCCORMICK *Edmonton, Alta.*

Manual Blowdown . . . When?

I DON'T AGREE with A E Richards on turning off oil burners for two minutes before blowdown (p 140, Feb POWER). I'd be in a swell fix if I did. Units would shut down in a hurry.

Anyway, it brings up a timely argument on which there are two schools of thought. What is the best time to blow down a small boiler? Some say do it when there is little or no load. Others say when boiler is steaming moderately.

I'll go along with the latter because I believe that under light load only a cone-shaped hole is made in the sediment when the valve is opened. Under moderate steam the sediment is agitated and more is discharged on blowdown.

ART CANNON
Laurence Harbor, N. J.

A Well-Founded Pain

MY JOB as a fireman is very fine,
Boilers steaming on the line,
But what gives me the bloody hump
They turn it into a garbage dump!

F HORN *Peterborough, Ont.*

Sorry—we can't squeeze a few more letters into this corner, but don't let that discourage you from rolling them in. We read them all and try to print a good cross section. So keep 'em coming —arguments, gripes and answers.—ED.

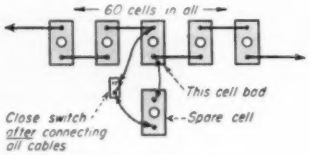
Superheated Steam Not for Lube

I AGREE with Ed Duff (p 133, Dec POWER) that engines using superheated steam should be lubricated.

As a matter of fact, I designed vertical, poppet-valve steam engines for ten years in Italy, and we were very careful to sell oilless engines for wet-steam use only.

Saturated steam is used with oilless engines because the condensation that takes place on the cylinder walls during expansion is enough to insure lubrication. But superheated steam cannot lubricate an engine.

DR M GIOMI *Albuquerque, N. M.*



Spare Cell in Parallel

I JUST READ through Coulden's piece, "Keeps Control Battery on Job" (p 136, Dec POWER). I've done the same job for many years in a much easier way.

All I do when a cell in any battery goes bad is parallel a spare cell with it as shown in the above sketch. Then, with the spare cell in the circuit, I disconnect the defective cell and replace it with a new one. When the new one is in position and tied in electrically, I disconnect my spare cell and the job is finished. Note, there is no interruption in service.

The drawback to Coulden's method is he would need four husky double-pole, double-throw knife switches. This in itself is some investment, and there's the possibility that some novice might put all the switches in the upright position, shorting out the 120-v control bus. Furthermore, even if only one switch is used at a time, one quarter of the battery is cut out of service.

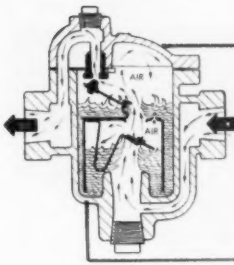
I have faced this job many times and carefully considered Coulden's rig. I have also tried using a resistor in parallel with the defective cell to keep the circuit closed while the bum cell was removed. But for my money the best bet is the spare cell in parallel with the defective one.

JIM SPARKS *Chicago, Ill.*

ARMSTRONG "BLAST" TRAPS SPEED UP HEATING

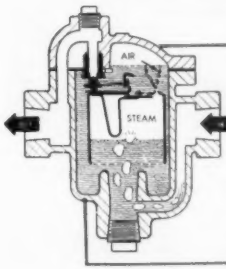
of Single Pipe Coils, On-and-Off Multiple Coils, Unit Heaters, etc.

AIR WHISTLES RIGHT THROUGH



VENT OPEN

Note large air bubbles "whistling" through large thermic-control vent to be discharged with condensate through open trap valve. Shaded grey area is condensate.



VENT CLOSED

After accumulated air and condensate are discharged, large vent closes. Small vent is always open to handle ordinary volume of air entering trap.

IN equipment where large amounts of air accumulate when the steam is turned off, and where the air can be pushed out ahead of the steam, Armstrong "Blast" Traps provide remarkably fast heat-up. A corrosion resistant invar and stainless bi-metal strip holds open a very large vent which lets air whistle right through the trap when equipment or lines are cold. As soon as steam reaches the trap, the bi-metal closes the big vent.

Armstrong Blast Traps combine the benefits of quick heat-up with the dependable service of mechanical traps. There is no bellows to leak or collapse due to high pressure. In fact, the traps are hydraulically tested at 500 lbs. pressure before they leave the factory.

Call your nearby Armstrong Representative for details and prices.

ARMSTRONG MACHINE WORKS

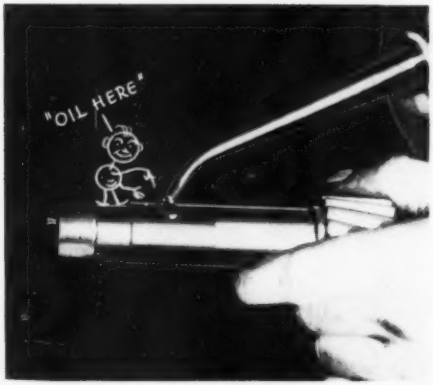
812 Maple Street • Three Rivers, Michigan

THE ARMSTRONG STEAM TRAP BOOK tells all about Armstrong Blast and Standard Traps—where to use them and how to select and install them. You are welcome to a copy. Just write for it.

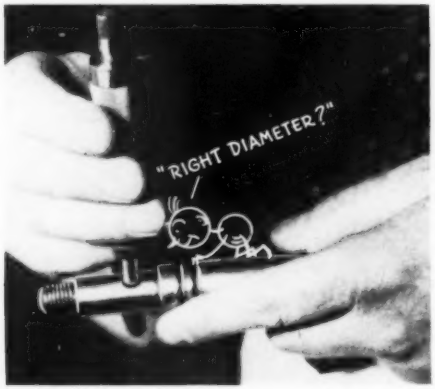
SEE OUR CATALOG IN SWEET'S

ARMSTRONG STEAM TRAPS

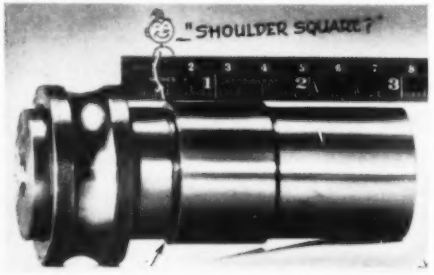
HOW TO Mount Ball Bearing On Shaft



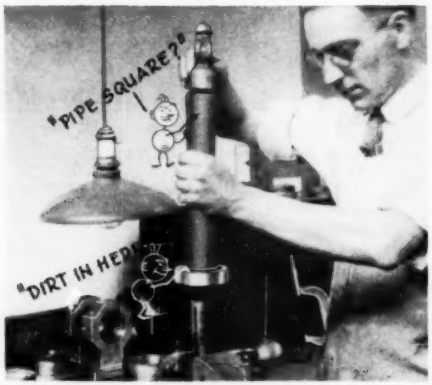
1 Clean grease from shaft, gear, threads with Stoddard's solvent. Then blow thoroughly with compressed air and clean dry with rag (not waste). Before pressing on bearing, place a few drops of oil over part that bearing slides over



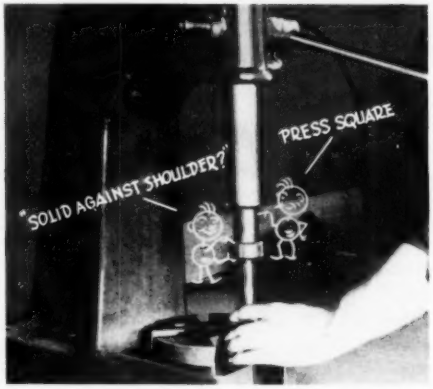
2 Shaft diameter must conform with manufacturer's recommendations for size of bearing. Use micrometer to measure for taper, also for diameter at bearing seat. Also check the shaft for burrs that might cause bearing to seat improperly



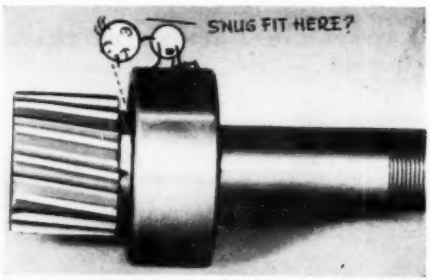
3 On old shaft where bearing is removed and replaced with new, carefully examine shoulder bearing will rest against. Shoulder shown is too small, and has given away under heavy thrust load. The new bearing against it may not be square



4 Place bearings on clean paper. Use clean pipe that has square end. *Caution:* Do *not* allow tiny scale particles from inside pipe to get in bearing being installed. Drive bearing onto the shaft until it is up solidly against the shoulder

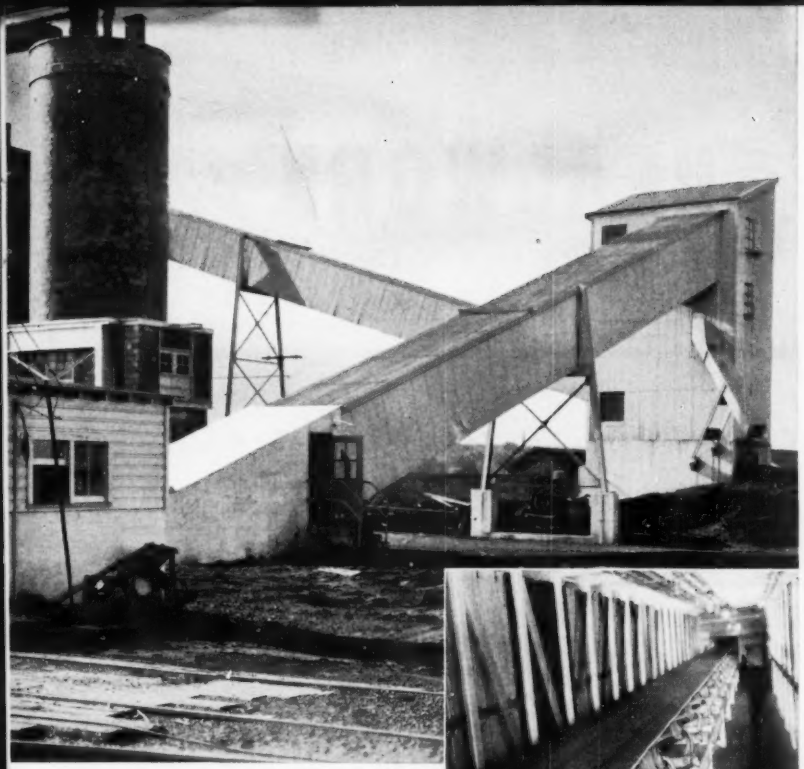


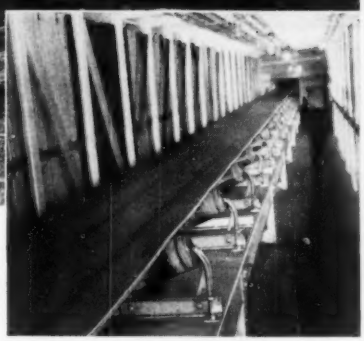
5 If you have arbor press, you can do a much better job. There is less chance of getting dirt into bearing. You can also be surer bearing is a good snug fit on shaft. Be sure to clean off arbor press so bearing won't give trouble



6 Where bearing fits up against a fillet on shoulder, make sure fillet is not larger than radius on bearing edge. If shaft fillet is too large, bearing won't rest against shoulder as it should.

Courtesy, Marlin-Rockwell Corp





Starts fast at forty below...

This belt conveyor carries coal from railroad cars to overhead hoppers for a power company located in the northern part of the Midwest . . . so far north that temperatures frequently hit forty below zero. Starting the conveyor in that kind of weather meant lost time, wasted manpower. The bearing lubricant became so stiff that five or six men often were required to pull on the belt. Three hours a day frequently were lost in getting the unit in operation.

As many as a dozen conventional lubricants were tried without success before a change to STANOLITH Grease No. 42 was made on the recommendation of a Standard Oil lubrication specialist. None could match the ability of STANOLITH to provide easy starting at extreme low temperatures, and still maintain effective lubrication during high summer temperatures.

STANOLITH Greases are filling the bill in a wide range of industrial and processing applications because of their resistance to heat and to the washing action of water, and their ability to flow readily under wide variations in temperature. A Standard Oil lubrication specialist can help you take advantage of these special properties. A call to your local Standard Oil Company office is all that's necessary. Or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANOLITH
TRADE MARK
Greases

What's your problem?

Meet R. R. Rowlands, of Standard's La Crosse office. He is the lubrication specialist who worked with this power company to find the right grease for an especially tough job. And as a result of his work, the company was able to save considerable time in the operation of a coal conveyor.

His on-the-job service is typical of that available to all midwest plants through a corps of such lubrication specialists. You can be sure that the specialist in your own area has both the practical experience and the training in a Standard Oil Lubrication Engineering School that will result in dependable, thorough assistance.

Why not call your local Standard Oil Company office today? Put a lubrication specialist to work on your problem now. When he calls, be sure to discuss the advantages and performance records of these outstanding products:

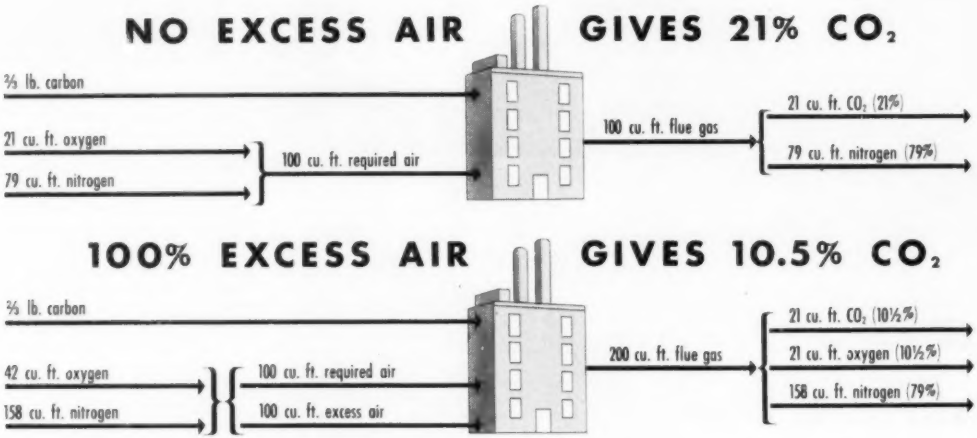
STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in air compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—These greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of open gears and chains, better internal lubrication of wire ropes.

STANDARD OIL COMPANY **STANDARD** (*Indiana*)

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH


NO EXCESS AIR GIVES 21% CO_2
⅔ lb. carbon
21 cu. ft. oxygen
79 cu. ft. nitrogen
100 cu. ft. required air
100 cu. ft. flue gas
21 cu. ft. CO_2 (21%)
79 cu. ft. nitrogen (79%)
100% EXCESS AIR GIVES 10.5% CO_2
⅔ lb. carbon
42 cu. ft. oxygen
158 cu. ft. nitrogen
100 cu. ft. required air
100 cu. ft. excess air
200 cu. ft. flue gas
21 cu. ft. CO_2 (10½%)
21 cu. ft. oxygen (10½%)
158 cu. ft. nitrogen (79%)

Why High CO_2 Saves Money

► EVERY ENGINEER knows that high carbon dioxide (CO_2) in boiler flue gas is a good thing, within certain practical limits. The reason isn't always as clear. It's *not* a matter of complete combustion.

Carbon, completely burned, turns to CO_2, so it's a natural mistake to assume that high CO_2 means the fuel has been completely consumed. Yet there's no connection between CO_2 percentage and the completeness of combustion; you can have it complete with 6% CO_2 and incomplete with 15%.

Well, then, what's wrong with low CO_2? Here's the real answer: *Low CO_2 is proof that flue gas is heavily diluted with a lot of excess air.* Since this excess air goes to waste up the stack at a fairly high temperature, it's a big money loss, "heating up the sky."

Now let's get down to some simple combustion arithmetic, but in a somewhat unusual form. Start with 100 cu ft of air. That happens to be just the amount theoretically needed to burn up 2/3 lb carbon, which will be our fuel supply for this example.

Air is 21% oxygen by volume. Only the oxygen really burns with the coal. The remaining 79% is nitrogen, which goes along for a free ride but doesn't have any chemical action.

One more point: When oxygen burns with carbon the volume of the CO_2 produced (figured back to room temperature) equals the volume of oxygen actually consumed. So now we can write: *2/3 lb carbon + 21 cu ft oxygen + 79 cu ft nitrogen = 21 cu ft CO_2 + 79 cu ft nitrogen.*

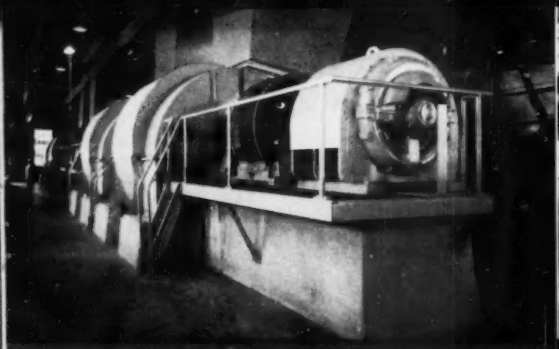
We start with 100 cu ft of air and end with 100 cu ft of flue gas. All of the oxygen disappears, and we find 21% CO_2 in the flue gas.

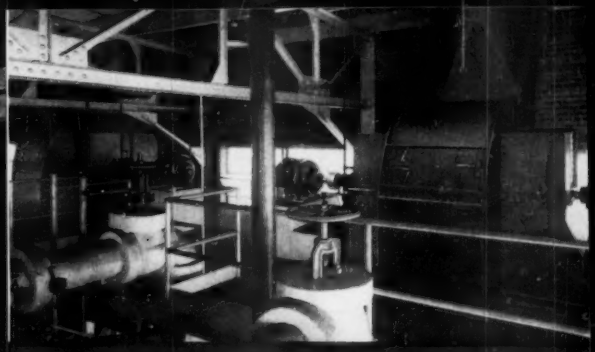
Now if you supply 200 cu ft of air, instead of 100 cu ft, to burn this 2/3 lb of coal, it will include 100% excess air. How will this show up in the flue-gas analysis? Remember that only 21 cu ft of oxygen can really burn here. Then: *2/3 lb carbon + 42 cu ft oxygen + 158 cu ft nitrogen = 21 cu ft CO_2 + 21 cu ft oxygen + 158 cu ft nitrogen.* Flue-gas composition is:

	Cu ft	*Percent*
CO_2	21	10.5
Oxygen	21	10.5
Nitrogen	158	79.0
	200	100.0

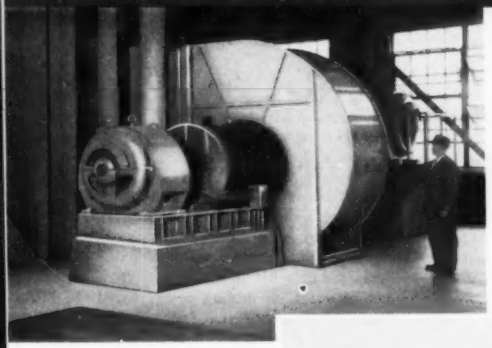
What happened? We doubled the total air supplied (100% excess air). As a result we cut the flue-gas CO_2 in half—from 21% to 10.5%. The sketches follow the same arithmetic.

This general idea holds true for actual fuels that aren't pure carbon. But don't try to use the foregoing figures for commercial fuels. Hydrogen in bituminous coal, also in fuel oil, changes the figures some. *More next month.*



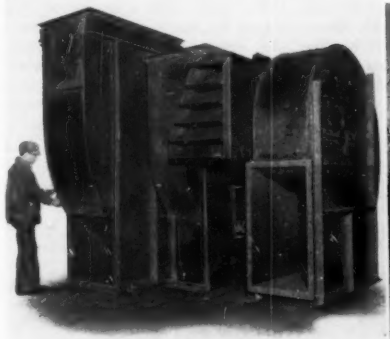


You'll Make the BEST CHOICE of DRAFT FANS from this COMPLETE LINE!

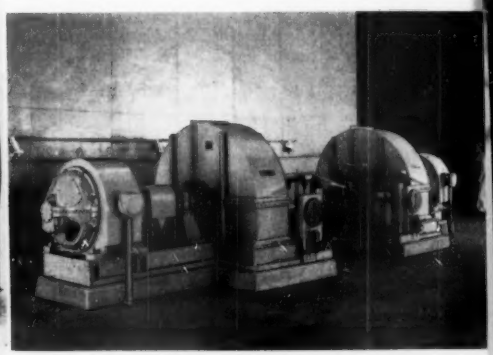


You can pick the best possible draft fan for the particular job because "Buffalo", pioneer manufacturer in the field, has developed a special fan for each job. Besides the fans illustrated here, "Buffalo" builds Sintering Fans; high-pressure Scavenging Blowers for Diesel-electric power plants; Over-fire blowers; and Industrial Exhausters for smaller induced draft installations. Why not investigate the construction and performance details that make "Buffalo" Fans the first choice for many of the country's leading power stations and plants? Write for Bulletin 3750 today, and look over this COMPLETE choice!

"Buffalo" FORCED DRAFT FANS give stable performance even when fuel bed is unusually heavy.



"Buffalo" COMBINATION DRAFT FANS are compact forced and induced draft fans with a common rotor shaft.



"Buffalo" PRIMARY AIR FANS blast pulverized coal and hot air into combustion chambers without letup.

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, NEW YORK

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VENTILATING FORCED DRAFT | AIR CLEANING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT PRESSURE BLOWING | EXHAUSTING

"The piston moved a little with each sock from the battering ram."

Tuffy Smith Traps Himself

►"ABRAHAM LINCOLN *was fond of opening Cabinet meetings by reading the latest story of Artemus Ward. Politicians like Stanton and Chase were shocked at this because they did not think Ward was as important as a battle. Lincoln suspected Ward was as important as a battle."—New York Times.*

That excerpt reminds us that for every letter we receive asking how come Marmaduke Surfaceblow finds himself in a serious technical magazine like POWER, we get 499 saying he's the first thing read.

If the great emancipator kept his sanity and perspective by reading lighter things in those troubled days of the Civil War, we feel that responsible engineers aren't too far wrong by keeping up with Marmy. So it didn't seem odd when a topnotch consulting engineer like Alex Higgins blew in from Canada and said he'd like to meet Marmaduke. Higgins is the author of those two popular McGraw-Hill books: *Engine Room Q & A*, and *Boiler Room Q & A*.

We walked down the street, turned a corner and climbed the old, creaky stairs leading above O'Houlihan's Machine Shop & Engine Works. The glazed-windowed door, with the bright red letters spelling out Marmaduke Surfaceblow, Esq. Consulting Engineer, was ajar. We walked in.

There, sound asleep, was Marmaduke, leaning back in his swivel chair, with his size 16 shoes propped up on his rolltop desk. The old gray bowler covered his face. All was quiet, but for what sounded like a blast of steam leaking from a high-pressure line.

His exhaust blower would start up and send the bowler a few inches into the air. Then as air rushed into his old intake pipe under his hat, the bowler would suddenly drop back into place.

And the air in that office had a familiar odor of Sandpaper Gin. Sure enough, there was an empty bottle of that potent beverage on his desk. We scraped our feet politely, wishing not to startle the old gent, but nothing happened.

Then we lifted a chair a few feet and let it crash to the floor. Still no response. We then picked up the empty bottle and clanged a glass against it, saying quietly, "The drinks are on us, Mr Surfaceblow."

That did it. Immediately his feet dropped to the floor like ship's anchors hitting a quiet tropical harbor after a long voyage. He sat up erect, shoved his bowler back on his head and popped his eyes a couple of times.

Before he could say anything, I introduced our friend. "Here's Alex Higgins from Canada,". I said. "He's in New York on business and wants to tell you about some work he's doing for an ore firm up there."

"Bilgewater on mining ore," roared Marmaduke, eyeing his empty bottle and looking at us suspiciously. "I'll tell you about putting a wrecked coal-mine plant back in circulation up in Canada." The old boy seemed to have a full head of steam, so we listened.

"'Back in 1898 I was headed south from the Klondike and stopped off at a coal mine near Calgary, Alberta," roared Marmaduke. "I was dead broke and wanted only enough cash to get me to Chicago. The mine boss said he needed a hoisting engineer.

"Now a throttle was a throttle, even if it was for hoisting coal. So I grabbed the job. That plant looked new, but any monkey-wrench engineer could tell without half trying that she was fouled up.

"There were six hrt boilers connected to a steam header. That long steam header was supported on concrete piers about six feet above the engine-room floor. But the joker was that it didn't have a single drain. I noticed that before I was in the plant two minutes. Also, I couldn't see a steam separator or trap anywhere.

(*Continued on page* 202)

A Nalco Representative checks over one of "his" plants with the plant engineer. Specialized training and experience make Nalco men your staff consultants on all water treating problems in your plant.

WATER TREATMENT SECURITY

for Your Plant with

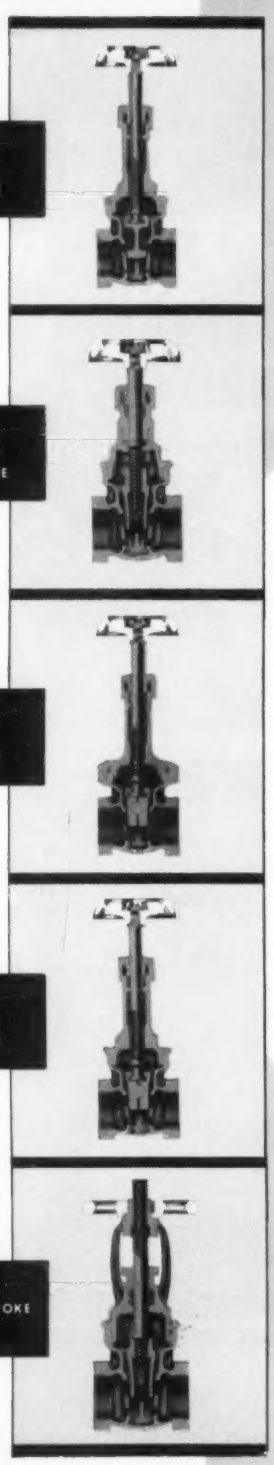
THE *Nalco* SYSTEM

WATER treatment security for your plant—as Nalco interprets it—means that aside from routine testing, control, and required inspections, you can stop worrying, *permanently* about steam purity, scale, corrosion, or other difficulties which might be caused by faulty water treatment procedures and chemicals. The Nalco System goes beyond a cursory survey and an order for chemicals. Your plant becomes the personal responsibility of your Nalco Representative; and he is backed by the entire facilities and personnel of the National Aluminate Corporation — nearly 600 skilled individuals who believe that effective industrial water treatment is up to Nalco standards only if each Nalco System plant is getting exactly the right treatment for the specific water, equipment and operating conditions involved. A postcard or letter will bring you further details on Nalco Water Treatment Security... Check on it today.

NATIONAL ALUMINATE CORPORATION
6222 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

In Bronze Gates



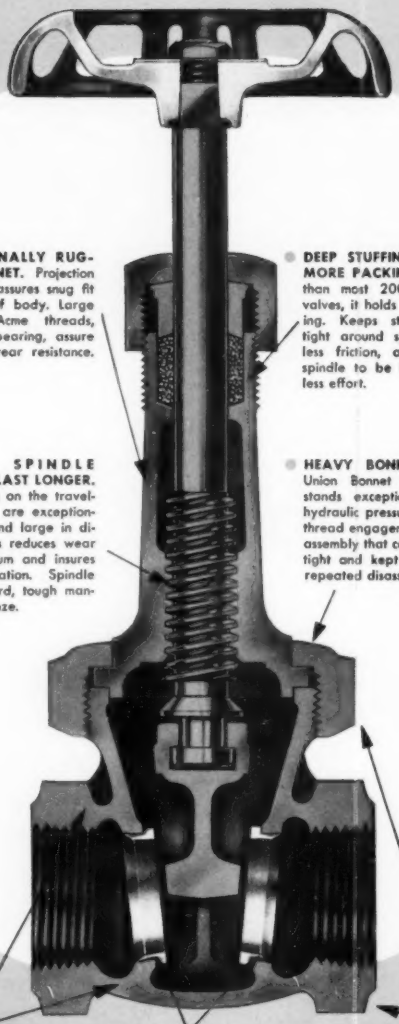
SOLID WEDGE
SCREW-IN BONNET
TRAVELING SPINDLE

SOLID WEDGE
SCREW-IN BONNET
STATIONARY SPINDLE

SPLIT WEDGE
UNION BONNET
TRAVELING SPINDLE

SPLIT WEDGE
SCREW-IN BONNET
TRAVELING SPINDLE

SOLID WEDGE
OUTSIDE SCREW & YOKE
RISING SPINDLE



EXCEPTIONALLY RUGGED BONNET. Projection on bottom assures snug fit into neck of body. Large diameter Acme threads, with long bearing, assure improved wear resistance.

DEEP STUFFING BOX—MORE PACKING. Deeper than most 200 lb. gate valves, it holds more packing. Keeps stuffing box tight around spindle with less friction, and permits spindle to be turned with less effort.

LARGE SPINDLE THREADS LAST LONGER. The threads on the traveling spindle are exceptionally long and large in diameter. This reduces wear to a minimum and insures easy operation. Spindle metal is hard, tough manganese bronze.

HEAVY BONNET RING. Union Bonnet joint withstands exceptionally high hydraulic pressures. Liberal thread engagement assures assembly that can be made tight and kept tight after repeated disassembly.

LIBERAL BODY DIMENSIONS ADD STRENGTH. Made of 35,000 lb. tensile strength cast bronze — has full length of pipe threads and liberal clearance between threaded ends and diaphragm wall. Union assembly reinforces and strengthens body neck.

"MONEL" SEAT RINGS EXPANDED IN BODY. The seat rings, expanded into place in the body, are equivalent to integral faces. The "MONEL" metal used is about 2½ times the hardness of valve body bronze — provides exceptional resistance to erosion and corrosion.

BODY AND BONNET RING LUGS. Rugged sturdy lugs of novel design on body ends and bonnet ring permit repeated application of open end, monkey wrench or pipe wrench, without "chewing off" corners.

that beat wear, cut care

JENKINS OFFERS 35 DIFFERENT PATTERNS

in pressures up to
300 lbs. steam—600 lbs. O.W.G.

JENKINS
FIG. 270-U Solid Bronze Wedge
FIG. 270-UN Nickel Alloy Wedge
Traveling Spindle — Union Bonnet
BRONZE GATES
200 lbs. Steam 400 lbs. O.W.G.

Jenkins Fig. 270-U offers exclusive features that are setting new records for operating economy. After an original service period that far outlasts that of ordinary valves, it can quickly be restored to new-like efficiency at a trifling cost.

Monel and Bronze Seating Combination adds Years of Extra Service Life

In Fig. 270-U, a high quality bronze wedge seats against MONEL rings expanded in the body. With this sensible design, the wear effects only the most accessible part—the bronze wedge—which can easily be replaced by slipping a new one on the stem when necessary. Records in every type of service prove it an excellent combination for longest service life.

Fig. 270-UN, with a nickel alloy wedge, is recommended for exceptionally severe conditions of rapid wear and corrosion.

The Gates for Industry's Toughest Services

Made in sizes from ¼" to 2", Fig. 270-U or Fig. 270-UN will provide unequalled economy in any service requiring a 200 lb. steam, 400 lb. O.W.G. Gate, especially where conditions are most destructive to valves, as in oil refineries, dye houses, chemical, food, and rubber plants.

Whatever your need in Bronze Gates, you'll find the right valve for the service in Jenkins complete line. Thirty-five different patterns are available for steam pressures up to 300 lbs., O.W.G. pressures up to 600 lbs. All are built to Jenkins time-tested valve engineering standards, and any pattern you choose is your best buy for lasting economy.

Leading favorites for extra endurance are the Jenkins Fig. 270-U and Fig. 270-UN. No other bronze gates offer the unique features that make them first choice for long life and trouble-free performance in the toughest services.

Despite their extra value, *you pay no more* for Jenkins Valves. For new installations, for all replacements, let the Jenkins Diamond be your guide to lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17. Jenkins Bros., Ltd., Montreal.

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS

GET THIS FOLDER. It gives detailed information on Fig. 270-U and other popular Jenkins Bronze Gates. Write Jenkins Bros. for Form 181-B, or ask your local Jenkins Distributor.

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK

Jenkins Bros

DEFENSE DIGEST

Your roundup of mobilization news and trends affecting power men

Revoked power-curtailment order in Pacific Northwest isn't a sign that the region's troubles are over. Order, which didn't have to be used because timely rains saved the day, was due for automatic termination March 31. DEPA Administrator Fairman says, "only if construction of dams can be kept on schedule during next and following winters will the hazard of shortage be reduced."

Changes are being considered in administration of the order next fall and winter; utilities are asked to make recommendations.

Coal production will increase to about 600 million tons in 1952, says Defense Solid Fuels Administration. Increased output of about 24 million tons should keep pace with record export needs and demands of expanding steel and power industries. Industrial stocks on hand in early part of this year were highest of any similar period in last few years.

Plenty of oil and gas is forecast by National Petroleum Council in report of its committee on availability. Looking ahead to 1955, the committee sees capacity to produce between 7.8 and 8.8 million bbl per day – 0.5 to 1.5 million more than at present. Estimate for 1955 gas is 9.5 to 11.9 trillion cu ft per year, about 1.5 trillion more than 1951.

Take these figures with a grain of salt. They're conservative, but they assume that "present economic incentives will be maintained" and that industry can get needed steel and manpower. And they're over-all figures for production from the ground. They don't assure that supplies of all refined products will meet demands or that there won't be local shortages because of transportation and storage difficulties, or pricing pinches such as caused trouble recently.

Revised list of allotment numbers and symbols, and DO symbols used by Federal claimant agencies to authorize production and construction schedules and in making allotments of controlled materials appeared in March 6 issue of Defense Production Record. Obtain from Supt of Documents, Government Printing Office, Washington 25, D. C. Single copies 5¢; $2.50 per year.

CMP out early in 1953? That's what some of the more optimistic mobilizers think may be possible. They pin hope on cuts in military needs caused by "stretch-out" in arms production, and new metals-production capacity now beginning to be felt. Restrictions on lead consumption are off already, non-nickel-bearing stainless steel is no longer a controlled material.

Program is visualized as gradual relaxing of controls toward end of 1952 with full-dress CMP ending next January. In place of full control, there'd be priorities, and specific limitations on metals still scarce – copper, for one, and some alloying materials, specific types of alloy steel.

But don't get too optimistic... any such change will be approached with great caution. And, while the over-all steel picture looks lots brighter, some products important to power men are still scarce. Boiler tubing will probably do better now that directive action has been taken but pressure piping is getting tougher – demand for nickel-bearing stainless steel runs more than twice supply, and difficulties in placing orders put pipe fabricators months behind schedules.

Heavy plate used in boiler drums is another tight item, mainly because of limited rolling-mill capacity for large plates.

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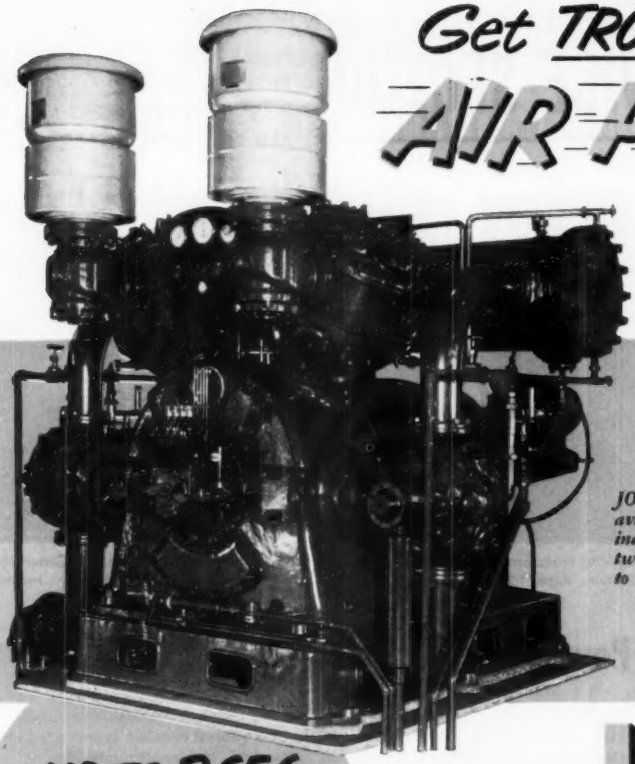

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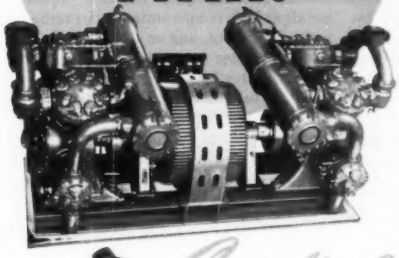

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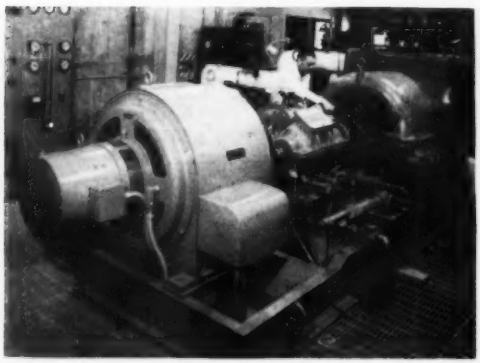
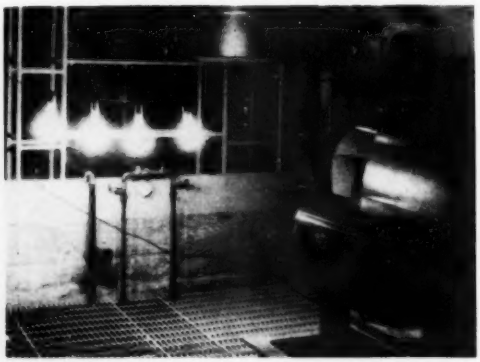
NEW FREE BULLETINS 165



THIS TURBINE and generator produced electricity from atomic energy at AEC National Reactor Testing Station, Arco, Idaho



FIRST ELECTRIC light produced by nuclear energy. Generator, *right*, operates on heat from experimental breeder reactor

Electric Power from Nuclear Reactor

The U. S. Atomic Energy Commission's national reactor testing station at Arco, Idaho, produced electric power from a nuclear reactor on Dec 20, 1951. This is probably the first time atomic energy has been a source of useable power.

The electricity came from the heat of the reactor, which made steam to drive the turbine and generator. They produced more than 100 kw, and used it to operate pumps and other equipment, and to provide light for the building. Liquid metal was used as a heat-transfer medium to remove the heat energy.

This reactor operates with *fast*, or high-energy neutrons, so one of AEC's chief technological problems was how to remove a large amount of heat from a very small reacting core. They found that liquid metals could do this. The experimental unit is now the first operating reactor to use molten metal in this way.

Power production from this reactor has no economic significance at this time, according to Dr Walter H Zinn, director of the Argonne National Laboratory where the pile was designed.

The unit is an experimental breeder reactor designed to find out whether they can create new nuclear fuel by breeding—that is, if they can produce more fissionable fuel than the apparatus consumes.

This reactor is the first major one operating with *fast* neutrons. It uses enriched uranium as fuel and a blanket of natural uranium around the core as *fertile* material where breeding takes place. The non-fissionable uranium-238 in the natural uranium is converted into new fuel, fissionable plutonium.

If they find that the conversion rate is faster than the burning rate, the AEC will consider the breeding operation successful. It may be some time before they know.

The power-generation phase is incidental. But it should provide experimental information on handling liquid metals at high temperatures under radioactive conditions, and on extracting heat from a reactor in a useful way.

The reactor is now presumably operating at full power rating. The AEC said in their *Tenth Semi-Annual Report to Congress* that it would produce experimental power only when they reached that point.

For Coming Events turn to page 192

FPC Authorizes 1463 Pipeline Miles

The Federal Power Commission during the last six months of 1951 authorized construction of natural gas transmission facilities that will add more than 350 million cubic feet of daily delivery capacity to the nation's individual pipeline systems. These new facilities involve 1,463 miles of natural gas pipeline, and estimated total construction cost is $86,498,922. Approximately $75,858,103 of the total construction cost is for major projects, estimated at $700,000 or more each. These larger projects will benefit 88 cities of 50,000 population or more in 18 states and the District of Columbia, as well as numerous smaller communities.

The largest single authorization dollar-wise was for El Paso Natural Gas Co, El Paso, Tex. They will expand system capacity by constructing an additional 10 miles of 30-in. loop pipeline, and installing 56,070 additional compressor horsepower in main line and booster stations in Texas, New Mexico and Arizona. The El Paso project is estimated to cost $23,400,000. It will deliver 100 million cubic feet of natural gas per day to meet increased requirements of existing markets in Texas, New Mexico and Arizona, especially Phoenix.

During the calendar year 1951, the Commission authorized construction of 6,091 miles of pipeline and installation of compressor units aggregating 426,500 horsepower. Total estimated construction cost is $471,383,184.

(*More Power News on page* 192)

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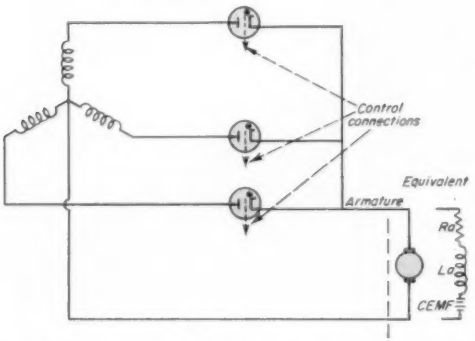
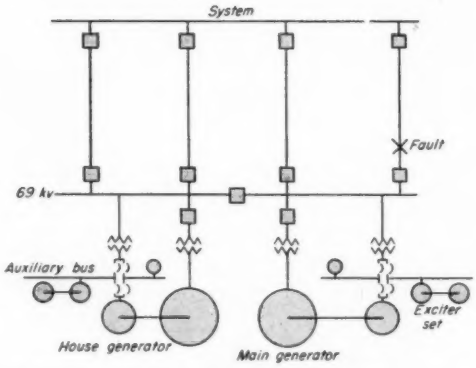


1 Equivalent electrical circuit eases tests for waveform shapes going into dc motor from grid-controlled rectifier



2 Greater reliability of power equipment increases exciter selection importance. System layout influences choice

Voltage Control

Increased Losses in a Dc Motor when Operated from Grid-Controlled Rectifiers. *By C Richard Reiter, Shell Oil Co, and Charles R Ammerman, Pennsylvania State College.*

When dc motors are operated from grid-controlled rectifiers there is an increase in motor losses. This means higher operating temperatures. These increased losses stem from the ripple in grid-controlled rectifier outlet.

Authors outline a theoretical analysis of voltage and current wave shapes supplied to a dc motor when operated from a grid-controlled rectifier. They further attempt to find the effects of various component wave shapes on motor losses.

For voltage and current wave shape analysis, motor has been replaced by its equivalent load of a resistance, inductance and battery (Fig. 1), representing the motor counter emf in series. Using this foundation, the authors found (1) effective and average voltage supplied by a grid-controlled rectifier can be calculated with good accuracy using Fourier series, neglecting the third and higher harmonics, (2) actual value of copper loss in armature compares well with the theoretical value, (3) copper losses increase moderately, less than 10%, but iron losses increase up to about 200%, (4) motor losses are not noticeably affected by operation of shunt field from the rectifier in Fig. 1.

Although only one machine was tested, the constants of this machine are of the usual order of magnitude. The authors believe that other shunt motors would have losses similar in magnitude and variation. *AIEE paper. No. 52-74.*

Selection of Characteristics for Turbine-Generator Motor-Driven Exciters. *By H G Frus, Duquesne Light Co, F N McClure and W H Ferguson, Westinghouse Electric Corp.*

Commutation problem of 3600 rpm direct-connected exciters increases about in proportion to their kw rating. When exciter rating is 250 kw or larger, it is best to use a slower-speed unit. Then you'll have fewer if any shutdowns for major exciter maintenance between scheduled shutdowns for main turbine maintenance.

You can have this speed reduction either by gearing exciter to generator shaft or using a separate motor drive (Fig. 2). The motor-driven exciter (mg set) has these additional advantages: (1) Exciter can be placed in more convenient location rather than at end of generator shaft. (2) Maintenance can be independent of main turbine and generator maintenance, assuming a spare excitation source is available. (3) Removing exciter from main generator foundation reduces commutation problem by reducing vibration.

Principal disadvantage of the mg exciter is that it may be dropped out if system faults. During periods of low voltage the mg set will slow down, reducing exciter voltage and response. Therefore, if the mg exciter is to be equivalent to a direct-connected exciter, its performance must be the same at minimum speed reached during any operating condition. This is generally possible if you provide sufficient flywheel effect, limit minimum speed to a reasonable value, and design exciter to have characteristics at this minimum speed that are equivalent to a direct-connected exciter.

The authors outline a simplified method of calculating applications of motor-driven exciters. *AIEE paper. No. 52-33.*

Experience with Automatic Voltage Regulation on a 115-MW Turbo-Generator. *By H A Cornelius and W F Cawson, Public Service Co of Northern Illinois, and H W Cory, Allis-Chalmers Mfg Co.*

The authors discuss various components used in a rotating amplifier automatic voltage regulator, and show how this regulator was used with a 115-mw generator at Waukegan station of Public Service Co of Northern Illinois. Generator in question has become unstable occasionally over the past 20 years. Unit was manually operated from 1930 when it was first placed in

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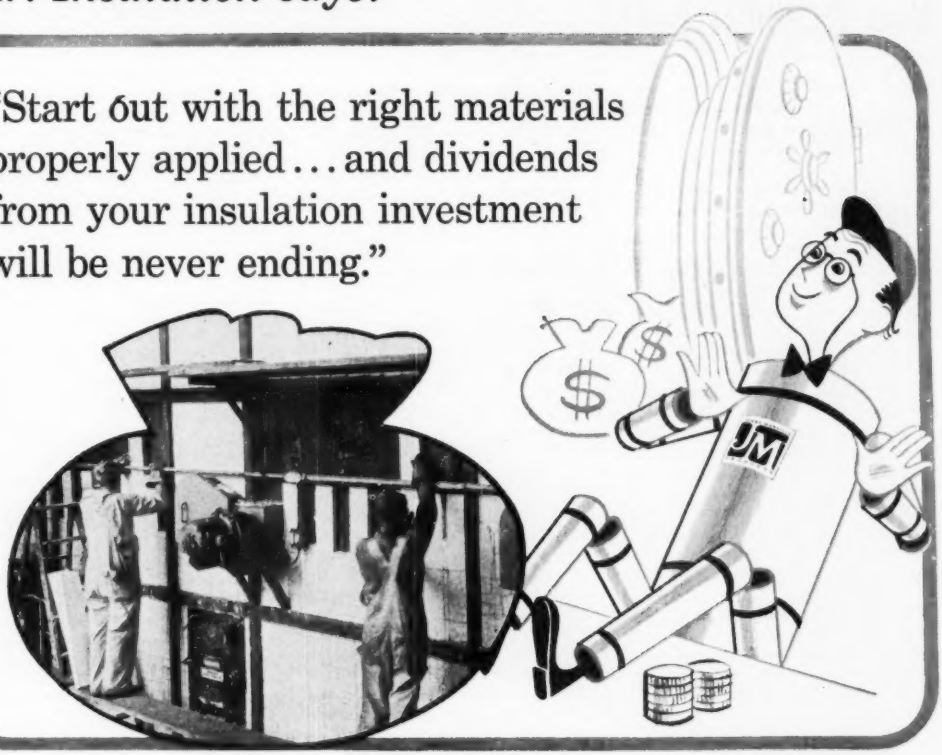

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More TECHNICAL BRIEFS

Begins on page 152

service through to the end of 1949.

Loss of synchronization or instability occurs because the generator terminal voltage decreases rapidly during a phase fault. The unloaded machine will then speed up. Regulator must quickly offset decrease in generator terminal voltage. The automatic voltage regulator discussed does this.

Two types of automatic voltage regulating equipment were investigated for this application. One type—the rheostatic-vibrating contact type—was eliminated because of its relative slowness. The other type studied — the static network-rotating amplifier type — was chosen.

The authors discuss at great length the characteristics of the main exciter, generator field time, transient stability, minimum limit control for field current, functions of automatic voltage regulating equipment, etc. The procedures used in the test are also outlined in the paper. *AIEE paper. No. 52-34.*

Performance of a New Magnetic-Amplifier Type Voltage Regulator for Large Hydroelectric Generators. *By G K Kallenbach, Niagara-Mohawk Power Corp, T L Dandeno, Hydro-Electric Power Commission of Ontario, F S Rothe and H F Storm, General Electric Co.*

Generator operating conditions on hydroelectric power systems call for voltage regulators with special features. This paper describes a new regulator designed to meet these needs. It also presents results of a series of tests made on systems of Niagara-Mohawk Power Corp and Hydro-Electric Power Commission of Ontario.

One important aspect of this new magnetic-amplifier voltage regulator is elimination of a direct-connected power exciter. It is replaced by a separate amplidyne motor-generator set. Because of the large power gain you get with the amplidyne, power requirements from the regulator are reduced, but you can still use a conventional single-field main exciter. Furthermore, you can modernize an older type excitation system without changing the exciter.

Because of high excitation needs for slow-speed main exciter, a larger amplidyne is generally required than for steam-turbine generators. Thus, for the bigger generators, as much as a 10-kw unit might be needed.

On all tests where the regulating system experienced a sudden voltage disturbance, the unit operated with high response of the amplidyne voltage. These tests show ability of the regulator to operate successfully under varied conditions of the present hydroelectric system. The authors outline details of regulator operation and describe the six tests performed. *AIEE paper. No 52-43.*

Fuels and Firing

Heat Absorption in a Natural-Gas-Fired, Watercooled Steam-Boiler Furnace. *By A R Mumford and R C Corey, Combustion Engineering - Superheater, Inc.*

This report is said to be the first comprehensive study of the distribution of heat absorption in a natural-gas-fired, watercooled steam-boiler furnace. The use of a fuel free of incombustible residue revealed hitherto unknown factors in furnace performance because ash was not present to mask the influence of such factors.

The tube surface temperatures on the furnace walls remained essentially constant at any given rating and excess air. Further, they were completely reproducible. After a lapse of more than a week a check test was made and it was found that the indicated tube surface temperatures were within a degree or two of their previous values. The obvious conclusion is that the shape of the flame envelope (invisible with natural gas) was independent of load at least with fixed burner position and at fixed mixing vane angles. There is no reason to suppose that the flame envelope and gas path in a furnace fired with pulverized coal would not also be the same at the same rating and excess air and with fixed positions of burners and mixing devices. This factor has not been apparent on previous tests because of the masking effect of variable ash deposits on the furnace tube surfaces.

When isotherms were drawn on plots of the furnace walls it was strikingly apparent that the pattern was similar at all loads with eight burners and with four burners. The gradient, or space between isotherms, varied with rating but the pattern was constant. This constancy of pattern indicated that, as long as burners and mixing devices were not readjusted, the hot gases would impinge on the walls at the same spots at all ratings and, therefore, that the path of gases through a furnace is determined by the burner position and the geometry of the furnace and not significantly by rating or excess air.

The usual flame, as observed in coal- and oil-fired furnaces, was completely invisible in this natural-gas-fired furnace. Computations of radiant transfer indicate that about 80% of the heat absorbed by the furnace was transferred by radiation. Estimates for luminous flames indicated that from 95 to 100% of the heat absorbed in the furnace is transferred by radiation. *ASME Paper. No. 51-A-147.*

Diesel Fuel Performance. *By R W Van Sant, Jr, Gulf Oil Corp.*

Optimum diesel fuel performance requires the proper balance of fuel characteristics, engine design and operation. Increasing proportions of catalytic cracked blends with straight-run fuel is now a market necessity. Catalytic cracked material and higher aromatic and olefin contents tend toward increased engine deposits under the medium-speed, low-load operating conditions that occur in many engine applications. By using the optimum characteristics of the engine design, however, deposit formations equal those of a straight-run fuel.

Improved performance of engine and fuel results from improved atomization and combustion. Atomization and volatilization improve by changes in injection pressure, spray pattern distribution and delivery rate. In addition to the improved combustion, the increased load and speed raise compression pressure, air charge temperature and turbulence to provide additional improvement. Under a particular set of higher

(*Continued on page* 188)

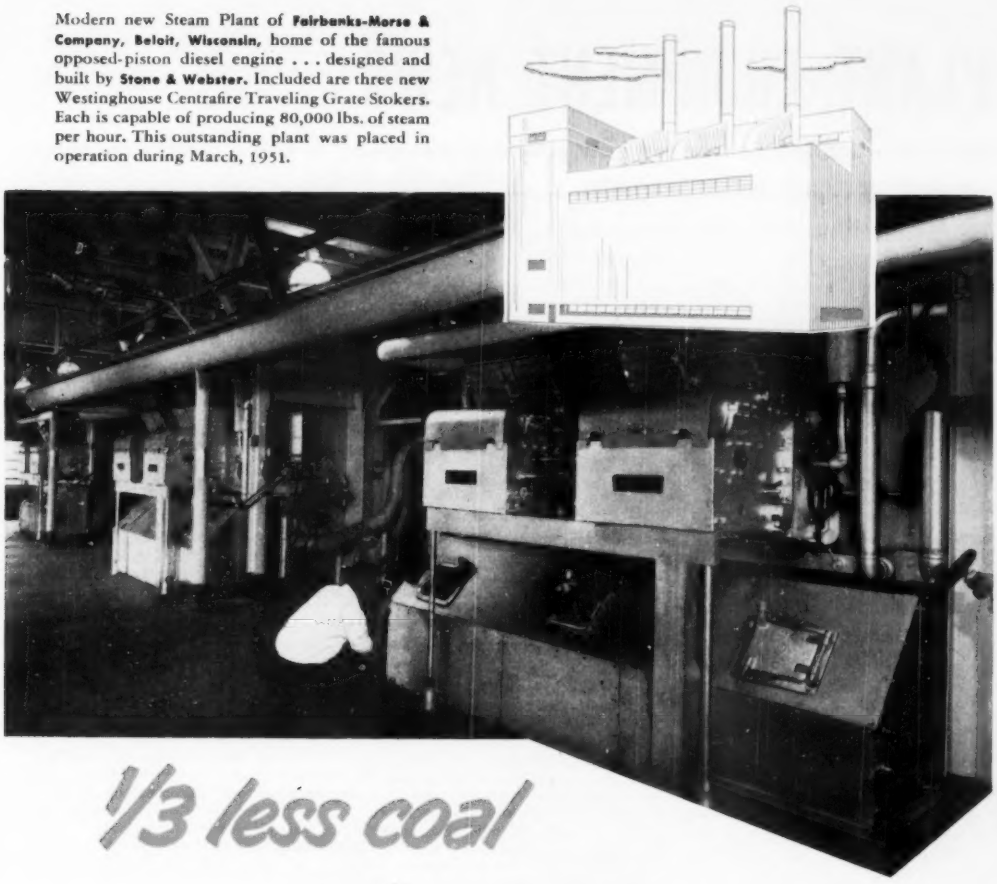
TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following source unless otherwise stated. Order complete paper from source not POWER.

American Society of Mechanical Engineers, annual meeting, Haddon Hall, Atlantic City, N. J., Nov 26-29, 1951. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers, winter general meeting, Statler Hotel, New York, N. Y., Jan 21-25, 1952. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, N. Y.

Modern new Steam Plant of **Fairbanks-Morse & Company, Beloit, Wisconsin,** home of the famous opposed-piston diesel engine . . . designed and built by **Stone & Webster.** Included are three new Westinghouse Centrafire Traveling Grate Stokers. Each is capable of producing 80,000 lbs. of steam per hour. This outstanding plant was placed in operation during March, 1951.



1/3 less coal

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Three Westinghouse Centrafire® Stokers with Traveling Grate, installed at the new Fairbanks-Morse Steam Plant, are establishing an impressive record of efficient and economical operation. Previous stokers operating under identical temperature and load conditions burned approximately 50% more coal than now is required by the new Westinghouse Centrafire.

Each pound of coal now produces more steam due to more complete combustion with a minimum of excess air. Accelerated response to changing steam loads makes operation easy. Requirements for operating and maintenance personnel have been cut considerably.

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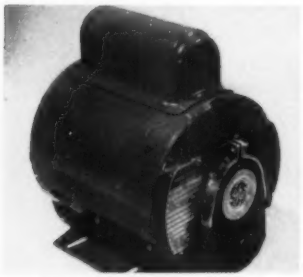

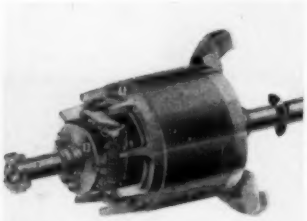

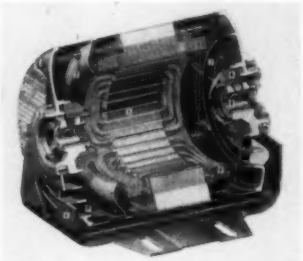

NEW MOTOR WEIGHS up to 51% less per horsepower than the models it replaces. Pictured is ½ hp, open drip-proof, capacitor-start *Form G*. Rotor winding is cast aluminum with integrally cast ventilating fins. Rotor locking device and thrust washer assembly maintain end play, absorb moderate thrust, need no maintenance. Stator, cased in lightweight steel shell, is of welded construction. Insulation is nylon combined with Formex insulated wire, Glyptal varnish.

SMALL, LIGHTWEIGHT, FRACTIONAL-HORSEPOWER MOTOR USES GLASS AND NYLON INSULATION

P422 • *Form G* motors are available in four types for various specific applications.

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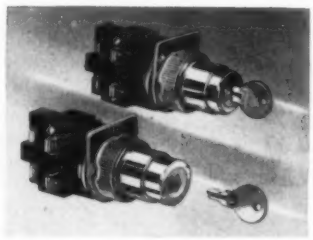
Light weight and small size are achieved by a balanced electro-thermal design plus more effective ventilation and generous use of aluminum for structural parts.

Insulation. New insulation system withstands moisture, oils, mild acids, alkalies, and aging. A specially developed nylon material is used in slot and between-phase insulation and wedges; windings are Formex insulated wire; red Glyptal varnish is baked on entire stator assembly. Split-phase motors, requiring more heat-resistant material in starting winding, have glass-insulated wire for additional safety from burnout. Leads are of a new braidless neoprene that retains flexibility and insulating strength through years of service.

Improved double-end ventilation keeps the *Form G* open drip-proof motor cool under continuous loads and prevents harmful accumulation of dirt inside motor. This general-purpose sleeve-bearing motor is recommended for all-angle operation, and can absorb moderate thrust loads.

Added Feature. For use where extra protection against dust, dirt, moisture, and foreign matter is desired, the *Form G* totally-enclosed fan-cooled motor requires little more space than standard drip-proof motor. *Form G TEFC* motors are available in ball-bearing general purpose and sleeve-bearing fan-duty models.

General Electric Co, Schenectady 5, N.Y.



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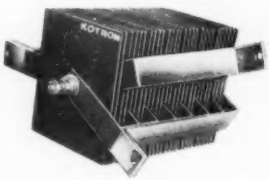
Pushbutton type allows key removal in depressed and undepressed positions, similarly, the selector-switch type allows key removal in any position.

They are mounted in identical round holes in panels 1/16 to 1/4-in thick without requiring an extra gasket, can replace the standard operator on Class 15-022 *Oil-Tite* pushbuttons for panel mounting, or in surface- or flush-mounting stations.

Westinghouse Electric Corp, Pittsburgh 30, Pa.



SELENIUM RECTIFIER

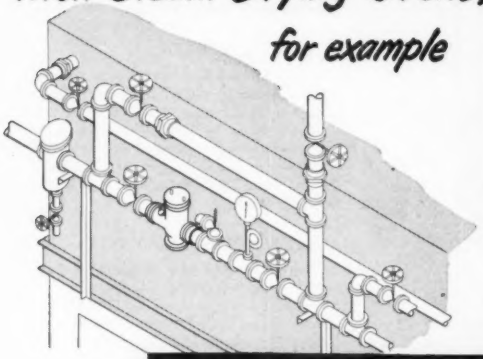
P428 • Selenium rectifier cell has capacity to withstand 60 volts rms, operates in 1-ph bridge connection, air-cooled, 35 C ambient maximum.

Kotron Electrifier Corp, 99 Sussex Ave, Newark 4, N.J.

(*Continued on page* 158)

Are Your Pressure Regulators Doing As Well?

...on Steam Drying Ovens, for example



THE INSTALLATION

In steam supply line to battery of 2 drying ovens at Ferro Chemical Corporation, Bedford, Ohio. Ovens individually controlled by thermostatic valves.

THE HISTORY

Specifications called for a valve to reduce initial steam pressure of 70 psi to 13 psi, and to maintain reduced pressure automatically without significant fluctuation whether one, or both, or neither oven is operated. Ovens to be operated at same or different temperatures, depending on process requirements.

Specifications were met with one No. 960 Crane Pressure Regulator, properly selected for capacity, and installed with adequate drainage of condensate.

In service now more than 5 years without interruption, Crane Pressure Regulator is giving complete satisfaction. Working like new; maintenance cost to date: zero. Remarkably simple to adjust.

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CORROSION-RESISTANCE:	Steam only - corrosion no problem
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OPERATING RESULTS:	No fluctuation of oven heat
PRICE:	Good buy
AVAILABILITY:	Regular Crane item

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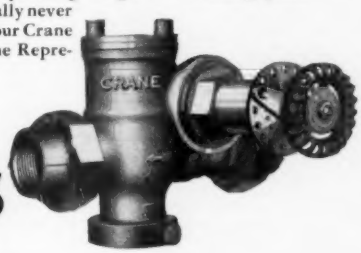
Crane No. 960 Brass Pressure Regulator reduces 250-Pound steam or air inlet pressure up to 80%. Available for operation at any of 4 pre-set ranges within 1 to 200 pounds outlet pressure. Adjusts easily within any set operating range. All wearing parts renewable; virtually never wears out. See your Crane Catalog or Crane Representative.



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Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

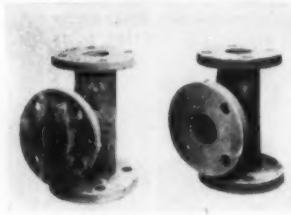
Begins on page 156

CLEAR PLASTIC-CELL STORAGE BATTERIES

P439 • Available in 2- and 3-cell sizes of 7 and 13 plates per cell, these *Exide* Type PLX batteries use clear polystyrene plastic containers and covers. They may be combined to supply any range of voltage with either 50 or 100 amp-hr capacity at the 8-hr rate.

Maximum insulation between plates is assured by triple separation in the form of microporous rubber separators, slotted plate protectors, and *Vitrex* retainers. Other features are the built-in explosion control device, polystyrene gas baffle mounted over each element, polystyrene cylinder gas-vent tube, and built-in pilot balls to indicate the approximate state of charge.

Electric Storage Battery Co, Philadelphia 2, Pa.



RUST REMOVER

P417 • *Rustclean*, a mild acid compound, chemically cleans surfaces. Leaves a phosphate coating ideal as base for organic paint finishes. There are two standard types, No. 12 for wipe-on applications by brush or spray and No. 15 for immersion coating of larger areas at elevated temperatures.

Technical Service Dept, Octagon Process, Inc, 15 Bank St, Staten Island 1, N.Y.

PANEL VENT SETS • P451

For use at free delivery or relatively low static pressures, these fans are available with wheels 24-, 30- and 36-in. dia. Air-moving capacities range up to 13,190 cfm. Vent sets have totally enclosed ball-bearing motors wound for dual voltage.

DeBothezat Fans Div, American Machine and Metals, Inc, E Moline, Ill.

For more data on these items, use post cards, p 165. Identify request with P and number.

STEAM CLEANER

P411 • Heavy duty, portable, all-electric JC-50 *Speedylectric* steam-jet cleaner uses the steam-detergent cleaning principle. It operates with 200 psi cleaning steam and a 400 psi hot or cold water rinsing jet—all under fingertip control. The JC-50 requires 30-40 kw, 220, 440 or 550v, 3 phase power, and a water supply of 250-300 gph.

Livingstone Engrg Co, 100 Grove St, Worcester 5, Mass.

WATER REPELLENT

P410 • Silicone-base water repellent for exterior masonry, *Dam-Tite* is a completely colorless liquid that penetrates masonry surfaces up to ⅝ in. It waterproofs the wall-pores without plugging or preventing air passage. Can be sprayed or brushed on.

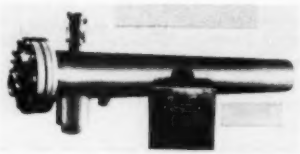
Speco, Inc, 7308 Associate Ave, Cleveland 9, Ohio

HIGH TEMPERATURE PAINT • P450

Thermalite maintenance paint protects metals subjected to temperatures from 200 to 1000 F. Applications include boilers, kilns, exhaust stacks, furnaces, melting pots, refinery equipment and laboratory apparatus. *Thermalite* is a high-heat aluminum paint. It presents a clean, smooth, silver-bright finish, combining good appearance with high heat resistance.

In addition to its main function of preventing rust and corrosion of hot metal surfaces, *Thermalite* offers good resistance to weather, chemical fumes and salt spray. It does not discolor, blister, flake or burn off in temperatures up to 1000 F.

Tropical Paint & Oil Company, 1210-52 W 70th St, Cleveland 2, Ohio



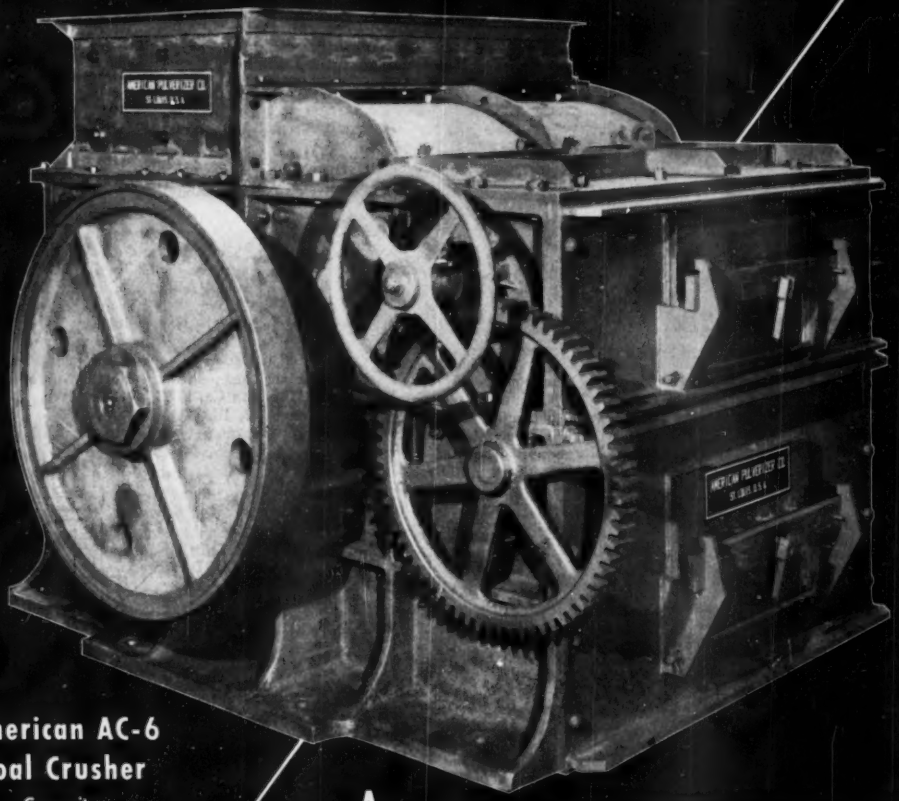
FUEL-OIL HEATER AND CONTROL

P404 • *Paraprobe* fuel-oil heater and control is designed to protect boiler from contamination by the heated fluid. Safety control is an electrical device that continuously monitors the condition of conductive fluids to detect undesirable contaminations. Exploratory electrode imposes a fixed low voltage on the liquid stream under scrutiny. If fluid is contaminated, control relay sounds an alarm. When used with oil preheaters, operation of oil burner and pump are also controlled. Safety control can be used in either below-the-waterline oil heaters or with steam heaters.

Davis Engrg Corp, 1064 E Grand St, Elizabeth 4, N.J.

(*Continued on page* 160)

QUALITY CLEAR THROUGH...



American AC-6 Coal Crusher

Capacity:
300 tons per hr.
ROM to ¾"

American Crusher quality is being constantly reaffirmed by case histories coming in from power plants, central stations and mines throughout the country . . . records which are proving beyond a doubt American's superlative performance and economy of operation. Here, for example, are the

Cost Surveys of 29 American Installations

Total Tonnage Handled.....61,000,000 Tons
Average Age of Crushers.....9.5 Years
Replacement Parts (Includes Standby Parts).....1/10 of 1¢ per Ton

THERE CAN BE NO BETTER PROOF OF QUALITY!

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE., ST. LOUIS 10, MO.

More EQUIPMENT NEWS

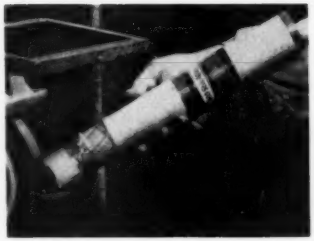
Begins on page 156

STICK WAX

P435 • A blend of special solid waxes put up in stick form, No. 140 *Stik-Wax* is said to provide a clean, durable lubrication for metal sanding, metal sawing, pipe cutting and threading, drilling, tapping, grinding, and flush riveting.

Stik-Wax can be applied manually or set in position to be automatically applied. It is packaged in a transparent wrap and enclosed in a cardboard tube. Each stick of wax is 2-in. in diameter and weighs 1 lb.

S C Johnson & Son, Inc, Racine, Wis.



CHECK THESE TOO! . . .

Light-Fluid Pump, balanced vanes ... p 170
Pipe Connector, bellows type ... p 172
Controller, pyrometric ... p 174
Electro-Oiling system ... p 174
Induction Motor, 2-pole ... p 177
Volt-Ammeter, split core ... p 178
Packing, teflon impregnated ... p 180
Pyrometer, 2 scale ranges ... p 180
Tube Cleaner, suspension type ... p 184

SIGNAL AMPLIFIER

P430 • *Regohm* converts low-power-level signals into control signals of a much higher power level. Plug-in unit, *Regohm Size 3*, can be used in voltage, current or speed regulation. It is adaptable to servo systems, rotating machinery, line and load regulation, rectification, battery charging, saturable reactors, and close differential relays.

Can be built with 20 standard fingers of 1-amp, 12-w capacity, or 10 extra-heavy fingers of 3-amp capacity. Fingers may be connected in parallel if control-circuit currents are higher. Auxiliary contact permits designing resistance banks with zero minimum resistance even in high current circuits.

A minimum of 1.5-w is required for coil current which is available in impedances from 0.01 to 10,000 ohms. Unit operates directly on dc or 50/60-cycle ac, and built in rectifiers can be provided for operation on other frequencies. *Regohm* measures 2 x 2 x 2 in and can be hermetically sealed if necessary.

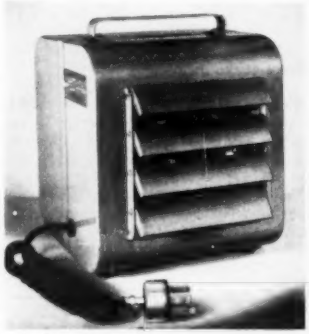
Electric Regulator Corp, South Norwalk, Conn.

HIGH TEMP GREASE FOR ROLLING-CONTACT BEARINGS

P453 • New grease exceeds established military and industrial standards in giving unusual protection at temperatures up to 300 F for continuous operation and 350 F for intermittent operation. Texaco high-temp grease is the latest formulation in a premium line which has been marketed for many years. This grease has excellent oxidation resistance, and similar desirable characteristics for high temperature work.

It far outran the hours-to-failure criteria of normal tests at 300 F and continued to exceed test specifications at even higher temperatures. An unusual characteristic of the new grease is the efficiency of its performance at high speeds as revealed in special ultra-high-speed endurance tests developed at Texaco's Beacon Laboratories. Water resistant characteristic makes it applicable in operations where long retention of grease and resistance to washing out are factors.

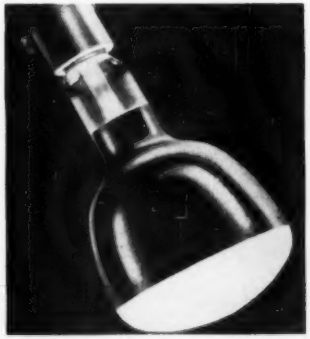
The Texas Co, 135 E 42nd St, New York, N. Y.



ELECTRIC SPACE HEATERS • P454

Combined portable and suspension-type industrial heaters are available in 1500-, 3000- and 5000-w capacities with manual or automatic temperature control. They may be plugged in temporarily or mounted permanently wherever heat is needed. Heating element has no exposed hot wires or glowing coils. Heat is dissipated rapidly, giving high Btu output at low operating temperature.

Electromode Corp, 45 Crouch St, Rochester 3, N. Y.



MERCURY LAMP

P427 • Producing 52,000 lumens at 1000 watts, this lamp was designed for industrial medium- or high-bay lighting. It has a life rating of 3000 hrs at five burning hrs per start, and 4000 hrs at 10 burning hrs per start. Operates satisfactorily in any burning position, and uses a 440-480v source.

Designated A15, the lamp has an overall length of 14¾ in.

General Electric Co, Nela Park, Cleveland 12, Ohio

(*Continued on page 170*)

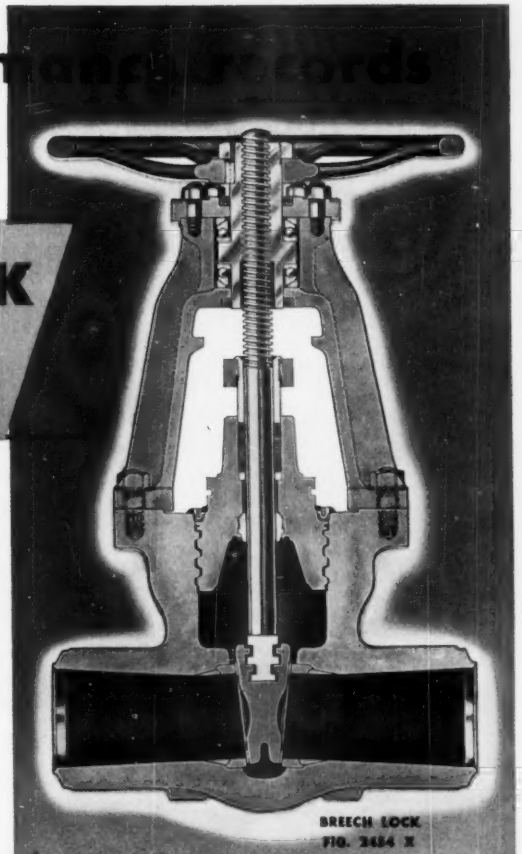
For more data on these items, use post cards, p 165. Identify request with P and number.

setting perform for 15 years

BREECH LOCK VALVES

These exclusive Lunkenheimer Valves are the *only* high-pressure, seal-weld valves proven in the field for more than 15 years.

They have consistently cut maintenance costs and "downtime" in hundreds of leading power plants . . . set the standard by which other high-pressure valves are judged. Here's why:



BREECH LOCK
FIG. 2454 X

Heavy intermeshing breech lugs in the body and bonnet carry full internal pressures—do away with the need for unstable gaskets, rings, flanges, and bolts. A light seal weld at the joint maintains pressure tightness. It can readily be chipped out, if necessary, for on-the-spot service. A forty-five degree turn of the bonnet engages or disengages the breech-lugs. There is nothing to wear out, nothing to fail!

WRITE FOR "Lunkenheimer Cast Steels," an invaluable booklet describing WC4, the exceptional steel used for Breech Lock Valves. The Lunkenheimer Company, Box 360A, Cincinnati 14, Ohio.

STEEL • IRON • BRONZE

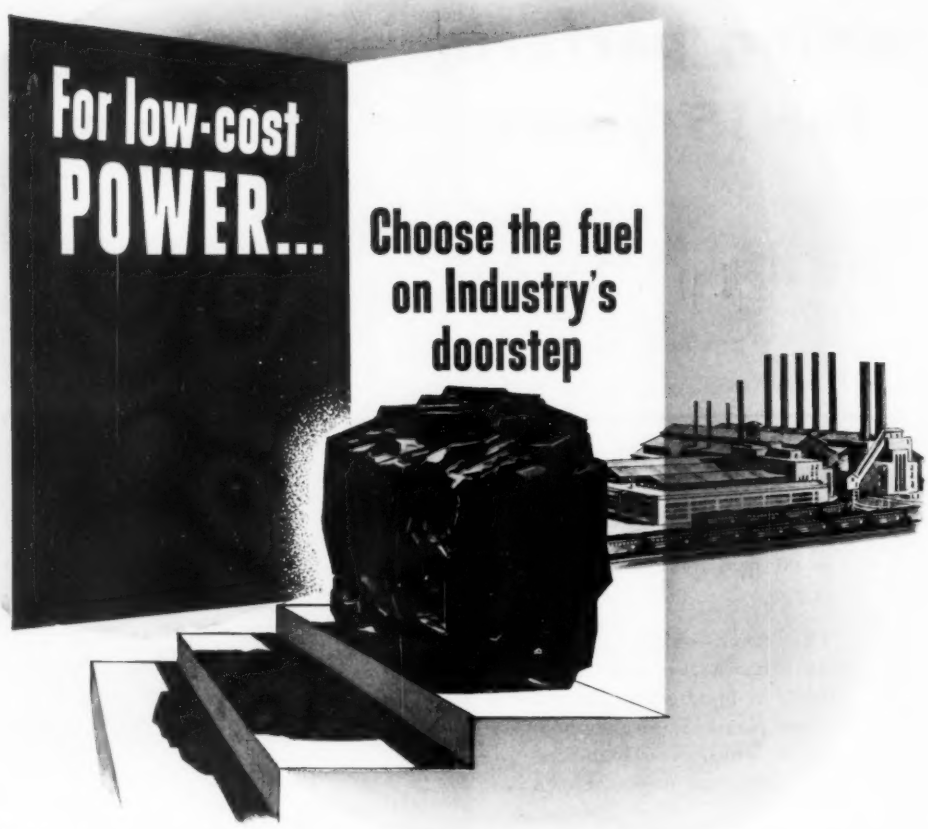
LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

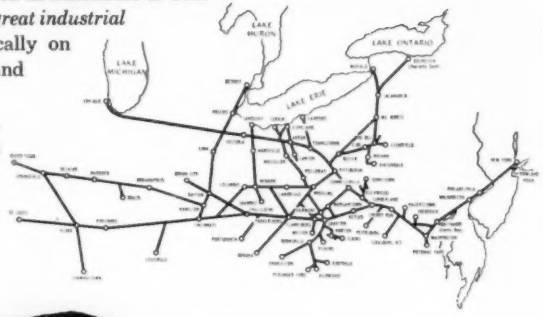
L-1052-4

For low-cost POWER...

Choose the fuel on Industry's doorstep



Coal is where you find it. Fortunately, however, a large share of the nation's operating Bituminous mines are located in Baltimore & Ohio territory—*economically accessible to America's great industrial plants.* The Bituminous mined here—practically on Industry's doorstep—is of excellent quality and in wide variety; whatever your specific need, there are B&O coals to meet it. Furthermore, the supply is *inexhaustible*—you can count on an *unlimited* reserve of B&O Bituminous, even in emergencies, for centuries to come.



When you consider fuel, consider cost—dependability of service—*accessibility.* You'll choose the Bituminous mined on the B&O. For advice, *ask our man!*

BITUMINOUS COALS FOR EVERY PURPOSE

LINKING 13 GREAT STATES WITH THE NATION — B&O ®

BALTIMORE & OHIO RAILROAD

Constantly *doing things* — better!

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your requests to the various companies, they'll send the info

Want quick direct-from-manufacturer service?

USE THESE CARDS

- First check what you need: more information on a new product or an ad, copies of free catalogs, bulletins
- Then describe the product, or literature desired. Give model numbers, bulletin numbers wherever you can
- Be sure to write in number of page on which item appeared, and issue of POWER in which you spotted it
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If you like this quick, direct-to-manufacturer service, we'll gladly send you a supply of cards

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Reader Service Department
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330 West 42nd Street
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I want details on these New Products... 4/52

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Company.....
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City, State.....

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☐ NEW PRODUCT ☐ ADVERTISEMENT ☐ LITERATURE

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Describe item here

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It appeared on page_____of the_____issue of POWER.

My Name.....
Please print

Title.....

Company.....

Street Address.....

City, State.....

This month's FREE Literature

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

B1 **FORCE-FLO HEATERS**—For hard-to-heat places where space and appearance are important. Quiet operation. 8-page bulletin DS-214 gives performance data, dimensions, capacities. Trane Co, La Crosse, Wis.

B2 **AIR DISTRIBUTION** — High-pressure dampers and outlets permit ventilation directly from main h-p duct. 4-page bulletin P 4960 gives noise-level, pressure-drop, performance data. Barber-Colman Co, Rockford, Ill.

B3 **CONDENSIFILTER** — Dehydrates and cleans compressed air. 20 cfm at 100 psi rated capacity. 3-page bulletin B20 shows components, specifications. Hankison Corp, 365 Ren-ton Bldg, 1501 Beaver Ave, Pittsburgh 33, Pa.

B4 **ELECTRIC AIR FILTER**—Cleans air with 90% efficiency. Standard and custom-built units. Capacity 1250 to 80,000 cfm. 8-page bulletin 20M-51 gives principle of operation, capacities, dimensions, specifications. Trion, Inc, 1000 Island Ave, McKees Rocks, Pa.

ELECTRICAL CONTROLS

B5 **CAM PROGRAMMER THERMOMETERS**—For time-temperature control. Single and dual models, electric and pneumatic control. 16-page catalog 4636 gives uses, advantages, specifications. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Ave, Philadelphia 44, Pa.

B6 **THERMAL CONTROLS**—*Thermoswitch* controls, sensitive only to heat. 52-page catalog No. 400 describes design, operating characteristics and installation of 10 variations on basic device. Fenwal Inc, Ashland, Mass.

B7 **TEMPERATURE SCANNER** — *Electronik* scanning recorder automatically monitors up to 276 temperature points, records those that deviate beyond preset limit. 4-page data sheet 10.0-8 gives description, operation. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Ave, Philadelphia 44, Pa.

B8 **PRESSURE CONTROLLER**—Non-indicating pressure pilot. Ranges 0-40 up to 0-1500 psi. 8-page bulletin 16-1 gives specifications, dimensions, design features. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Ave, Philadelphia 44.

B9 **WARNING SYSTEM**—*Multalarm* units indicate emergency conditions. Audible and visual signs, automatic reset. Any number of stations and alarms. 4-page bulletin 7411 gives details. Automatic Control Co, St Paul 4, Minn.

ELECTRICAL EQUIPMENT

B10 **FAN-COOLED MOTORS**—Standard and explosion-proof designs. Tube-type, air-to-air heat exchangers; ratings from 40 hp at 600 rpm through 800 hp at 3600 rpm. 6-page bulletin 51B7149B shows construction and installations. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee.

B11 **EXPLOSION-PROOF MOTORS**—2 to 100 hp (fan-cooled), and ½ to 2 hp (non-ventilated). Enclosed external air passages eliminated. Bulletin 51B7200A gives details. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee.

B12 **VARIABLE-SPEED DRIVES**—Five types of all electric drives, ¼ to 200 hp. Unlimited speed selection over entire range. 8-page bulletin D2311 gives non-technical explanation, shows hp and torque characteristics. Reliance Electric & Engrg Co, 1052 Ivanhoe Rd, Cleveland 10, Ohio

B13 **CUBICLE SWITCHGEAR**—Industrial and station type designs. Built-in airblast breaker. Factory-assembled, completely wired. 16-page bulletin P 011-2053 shows construction, ratings, specifications. Brown Boveri Corp, 19 Rector St, New York 6, N. Y.

(Continued on page 220)

HERE'S YOUR *Complete* STEAM PLANT

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.
- For complete details, write today for catalog 401.

SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES, Inc.

Factory: Emmaus, Pa.

Executive Offices: Times Building, Times Square, New York 18, N. Y.

Photo by Ewing Galloway

I'm Using My Head to Balance My Load

SURE OSCAR, WE'RE LOOKING—and we think that's a real cute trick, but why not try keeping both feet on the ground instead? Then you could raise your head high enough and open your eyes wide enough to see what's going on in the world. You'll then discover many more practical ways to balance your load.

This flamingo's trick of solving a purely mechanical problem might look silly to most power engineers, but I'm not laughing. I've been in this game too long and operated too many plants to laugh at his antics.

Too often a plant operator keeps his head so close to his feet that he can't balance his load. Like this silly flamingo, he thinks he's doing a real job, but that's only because he hasn't had his head far enough from home plate to compare his wasteful methods with neighbors' more advanced practices.

And characters like this guy don't even bury their heads in a technical magazine to see what's going on in their field. That's too bad, because as Fred Low, that grand old chief editor of this magazine said many years ago, "You don't have to be a college graduate to run a smooth plant. Just go through each POWER issue thoroughly, then put the information to work in your plant."

So raise your head and see what's going on, Oscar. You'll find that money spent on balancing your load the right way ups efficiency and cuts labor. And it's the ONLY money that pays dividends in a power plant.

Think that over, my fine-feathered friend.

George Edwards

Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

Dowell Service saved $87.92 in steam per day!

Dowell Service was used by a major steel company to clean a large turbo blower condenser. After the cleaning, operating figures showed a saving in steam of 8000 lb. per hour or a dollar saving of $87.92 per day. At this rate, *Dowell Service paid for itself in 5½ days!*

There are many places in every industrial plant where Dowell Service can be used to cut operating costs. Wherever deposits on the surfaces of condensers, boilers, heat exchangers, water lines and other equipment are stealing power, Dowell Service can show money-saving results.

Dowell Service has another prime advantage for the maintenance engineer. *It is fast!* Because cleaning is done chemically, time-consuming dismantling is eliminated. Dowell engineers fill the equipment with liquid solvents that go wherever steam and water flow. These solvents are designed to remove deposits quickly, efficiently and economically.

Do you have a cleaning problem, too . . . a place where deposits are causing a maintenance headache? Call Dowell. Skilled cleaning engineers are available for consultation at no obligation.

Other recent Dowell jobs:

In a large textile plant, the heating time required in kier heaters was cut one-third, following cleaning with Dowell Service.

•

Houdry catalyst cases cleaned by Dowell Service for a large refinery showed all tubes to be practically metal clean and orifices opened.

•

Thirty-three year old water well, cleaned by Dowell Service, showed increase from 64 to 130 g.p.m. with drawdown decrease of 27 feet.

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

CALL

New York 20	Pittsburgh 19	Ft. Worth 2	Mt. Pleasant, Mich.
Boston 16	Detroit 2	Shreveport 69	Hamilton, Ohio
Philadelphia 2	Chicago 4	Atlanta	Charleston, W. Va.
Baltimore	St. Louis 8	Indianapolis	Salem, Illinois
Wilmington 99	Kansas City 8	Louisville	Beaumont, Texas
Richmond 19	Wichita 2	Upper Montclair, N. J.	Borger, Texas
Jacksonville 2	Oklahoma City 2	Anniston, Alabama	Midland, Texas
Buffalo 2	Houston 2	Hattiesburg, Miss.	Wichita Falls, Texas
Cleveland 13	New Orleans 12	Lafayette, La.	Hobbs, N. Mex.

★ *Maintenance cleaning service for industrial heat exchange equipment.*

★ *Chemical services for oil, gas and water wells.*

DOWELL

A Service Subsidiary of

THE DOW CHEMICAL COMPANY

FOR RELIABLE, ECONOMICAL POWER

A MIDWEST REFINERY installed . . . BOILERS BY Bigelow

Bigelow Types F, FH and FHC boilers are available in capacities from 20,000 to 100,000 pounds of steam per hour. Design pressures range from 160 to 450 lbs. p.s.i. These boilers are designed for oil, coal, gas or combination oil and gas firing.

For further information on any of the boilers listed write for free catalogs or contact your nearest Bigelow representative.

BOILERS BY BIGELOW

Water Tube Boilers — Bent Tube Types
Horizontal Return Tubular Boilers • Scotch Type Boilers
Two-Pass Boilers • Electric Steam Generators

One of the two Bigelow Type FHC Boilers installed recently at a midwest refinery. Installation is semi-outdoor with the firing fronts of the boilers inside the building.

Capacity — 40,000 lbs. each. Design pressure 250 lbs. Fired by combination #6 oil and gas burners. Boiler furnace side walls are completely water walled. Setting is tile, insulating block and steel casing.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

BIGELOW REPRESENTATIVES: Boston • New York • Chicago Philadelphia • Syracuse • Detroit • Atlanta • Milwaukee New Orleans • Oklahoma City • Petersburg, Va. • Washington, D. C. San Francisco • Los Angeles • Seattle • Knoxville

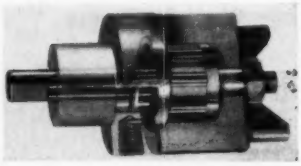
More EQUIPMENT NEWS

Begins on page 156

CHAMFERING ELECTRODE

P419 • Specially formulated electrode, the *ChamferTrode*, features a heavy coating that forms a cone at striking end of the electrode, gives a natural jet-effect arc. This intense, concentrated heat source is said to speed up fabricating armor plate and similar difficult-to-cut alloys.

Dept P, Eutectic Welding Alloys Corp. 172nd St and Northern Blvd, Flushing 58, N.Y.



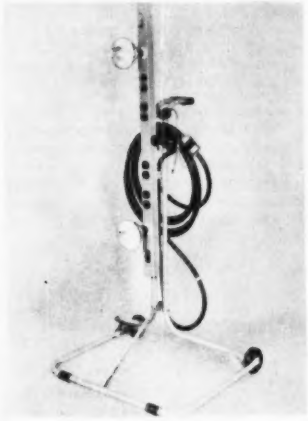
LIGHT-FLUID PUMP • P455

Magna-Mite is a compact positive-displacement pump with a capacity from 1½ gpm down to ¼ gpm or less. Similar to vane-type pumps, vanes in this unit are replaced by rollers that contact outer case, rolling friction replacing sliding friction. Pump life is said to be increased three to five times. Vanes are hydraulically balanced.

Available in three major types: Type A, constant displacement, Type B, adjustable displacement and Type C, variable and reversible displacement. All three run in either direction in any position.

Milwaukee Hydropower, Inc, 3447 N 35th St, Milwaukee 16, Wis.

For more data on these items, use post cards, p165. Identify request with P and number.



PORTABLE BRANCH-CIRCUIT EXTENSION

P449 • A series of portable branch-circuit extensions literally roll power, light, or

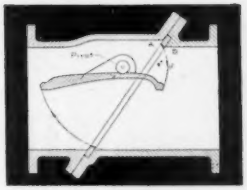
...as much as 65% to 80%
BY
CHAPMAN
Tilting Disc CHECK VALVES

Typical test on a 22-inch Chapman Tilting Disc Check Valve under 450 pounds gas pressure . . . carrying 3,200,000 feet of gas per hour . . . showed a drop in pressure of less than 7 inches of water.

The average reduction of head loss . . . as against conventional check valves . . . is 65% to 80%.

That's because the balanced hinge-pinned disc, of special aerofoil design, has exceptional lifting qualities, lightness in unbalanced weight, and minimum resistance to flow in open position. And valve body is streamlined, with through-way always equal to the area of the pipe.

This means that *disc won't slam* under usual piping arrangements ...and that it seats drop-tight. It means, too, that many new lines can be designed in smaller size. Send for Catalog No. 30, giving complete data and test-curves on Chapman Tilting Disc Check Valves.

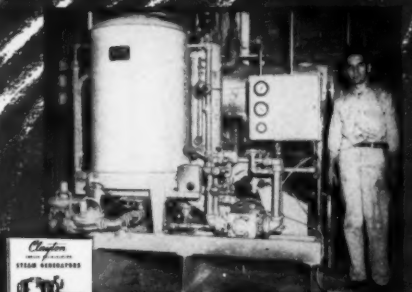


Cross-section of the Chapman Tilting-Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS

PROCESSING
STEAM
at LOWER COST

- BECAUSE:
- fuel savings of from 20% to 50%
- full operating pressure in 5 minutes from a cold start
- instant recovery to meet any pea demand within rated capacity
- simple, safe and foolproof cont of feedwater and fuel
- no expensive standby sses
- low installation cost er or pump to inst stack or accesso
- less spa per hor



To learn how this 50 h. p. Clayton Forced Recirculation Steam Generator reduced steam production costs by 70%...MAIL THE COUPON

Send name of nearest distributor and arrange desk demonstration of Clayton *Forced Recirculation* principle. Send catalog. P-4

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

Animated flow chart shows how *Forced Recirculation* principle cuts steam costs.

Clayton MANUFACTURING COMPANY
BOX 550, EL MONTE, CALIFORNIA

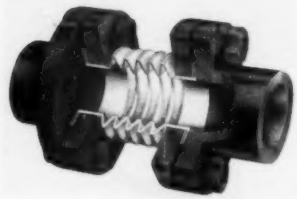
More EQUIPMENT NEWS

Begins on page 156

heat to any location in industrial maintenance work, on temporary assembly lines, on construction jobs, or in underground construction and repairs. Known as the *NE Rolla-Duct* series, the units are collapsible and fully portable. Series includes a power and light unit, a strip of flood lighting and a strip of infra-red heating units.

Strips are fully grounded and provided with a circuit breaker for worker protection. Carrying 21 ft of power line, the units are approved for 20 amp loads on 115- or 220-v operation.

National Electric Products Corp, Pittsburgh 19, Pa.

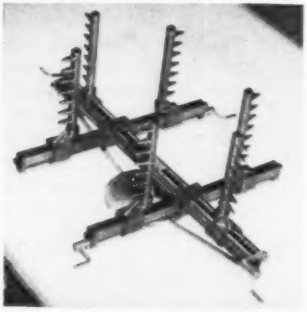


BELLOWS PIPE CONNECTOR · P456

John Crane bellows-type pipe connector is fabricated of chemically-inert teflon, retains its flexibility and strength at high and low temperatures. It is useful where vibration, expansion and electrolysis exist in handling corrosive liquids, gases and solvents. Joint end flanges are French-type envelope gaskets integral with joint for easy assembly between companion flanges.

Crane Packing Co, Dept Q22, 1800 Cuyler Ave, Chicago, Ill

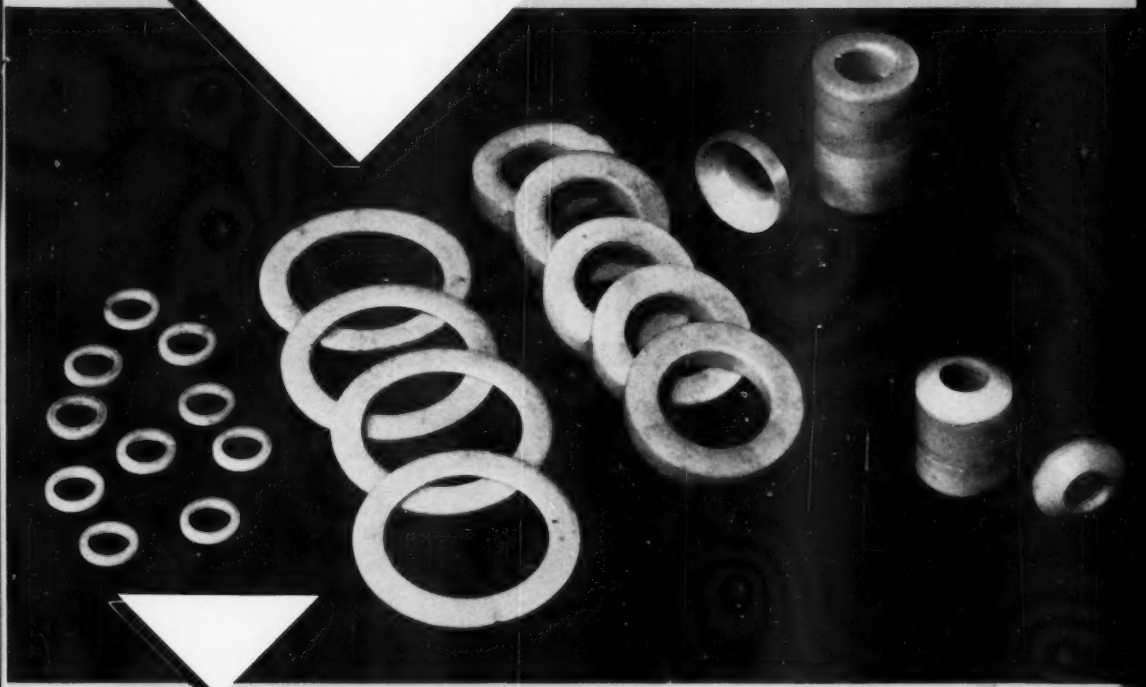
For more data on these items, use post cards, p165. Identify request with P and number.



THREE-PHASE WINDING HEAD

P432 · *Three-phase head* winds mush-type coils for ¼- to 75-hp motors and can wind coils from 2¼ x 5 in. to 11½ x 19½ in. Featured is an instantaneous tension release. When in operation, arms are held

ANKLON . . . Made of TEFLON



RECOMMENDED for all types of Valve Stems, Rotating and Reciprocating Shafts

BRANCH OFFICES

BALTIMORE, MD.	MILWAUKEE, WIS.
BOSTON, MASS.	MONTREAL, CANADA
BUFFALO, N. Y.	NEW ORLEANS, LA.
CINCINNATI, OHIO	NEW YORK, N. Y.
CHICAGO, ILL.	PHILADELPHIA, PA.
CLEVELAND, OHIO	PITTSBURGH, PA.
DAYTON, OHIO	SAN FRANCISCO, CAL.
DETROIT, MICH.	SEATTLE, WASH.
HOUSTON, TEX.	SPOKANE, WASH.
INDIANAPOLIS, IND.	ST. LOUIS, MO.
LOS ANGELES, CAL.	TOLEDO, OHIO
WILMINGTON, CAL.	

Anklon is a superior plastic packing, fabricated by The Anchor Packing Company from Du Pont's Teflon and formed into sheets, rods, angular rings and blocks.

Because of the inert physical qualities of Anklon, packings, gaskets and machined parts made of this product are ideal for use against acids, solvents and alkalies and also have many desirable characteristics for application in the electrical, food processing and many other fields.

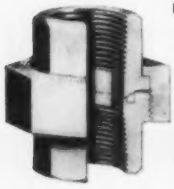
Illustrated are Anklon machined packing sets ideal for use on slow moving rotary and reciprocating equipment and excellent for all types of valve stems. Anklon seals with low gland pressure. Flat adaptors are furnished when necessary. Where small valve stems are unable to utilize wedge or angular ring sets, solid unit rings are supplied. For full information, write today.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE



BRASS SEATING
exclusive with
JEFFERSON
assures leakproof joints

Jefferson UNIONS
AIR-TESTED AIR-REFINED MALLEABLE IRON
featuring the RECESSED BRASS SEAT

The Recessed Brass Seat—incorporated in all Jefferson Unions—provides a joint having *surface* contact and located in the raceway of the fitting where pipe ends cannot come in contact with it. Location also is such that there is no obstruction to free flow. Tightness is assured without the necessity of jamming.

Jefferson brass seats consist of rings cut from special tubing (not cast) which are press fitted into *machined* (not cast) ring channels. Seats definitely cannot rock or work loose.

Jefferson, in addition to its regular line, can furnish AAR male and female unions, Enduro 300#, Excel 250# and Master 150# unions. Ground, all-iron seats can be furnished when desired.

Ask for further details—through your nearest distributor or from us direct.

Jefferson UNION CO.
605 W. 26th ST., NEW YORK 1, N.Y.
63 Gooding St., Lockport, N.Y. 39 Fletcher Ave., Lexington 73, Mass.

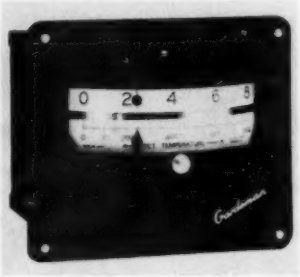
More EQUIPMENT NEWS

Begins on page 156

rigid with teeth turned out. When coil is finished, operator pulls out on arms and turns teeth to inside releasing tension.

Four cranks adjust coil winding arms in pairs equidistantly from center of the winding head. Scales on each bar show setting for coils for any of above sizes.

Crown Industrial Products Co, 1025 Park and Borden Ave, Sycamore, Ill.

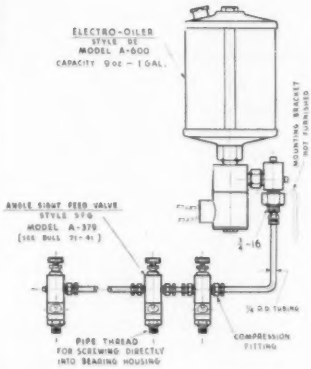


PYROMETRIC CONTROLLER

P420 • Proportioning, indicating pyrometric controller, Model *JP Gardsman*, automatically adjusts the ratio of power on-and-off, over a given time cycle. Maintains any desired temperature set by the index pointer. It is of special interest in extruding and industrial heat-treating fields.

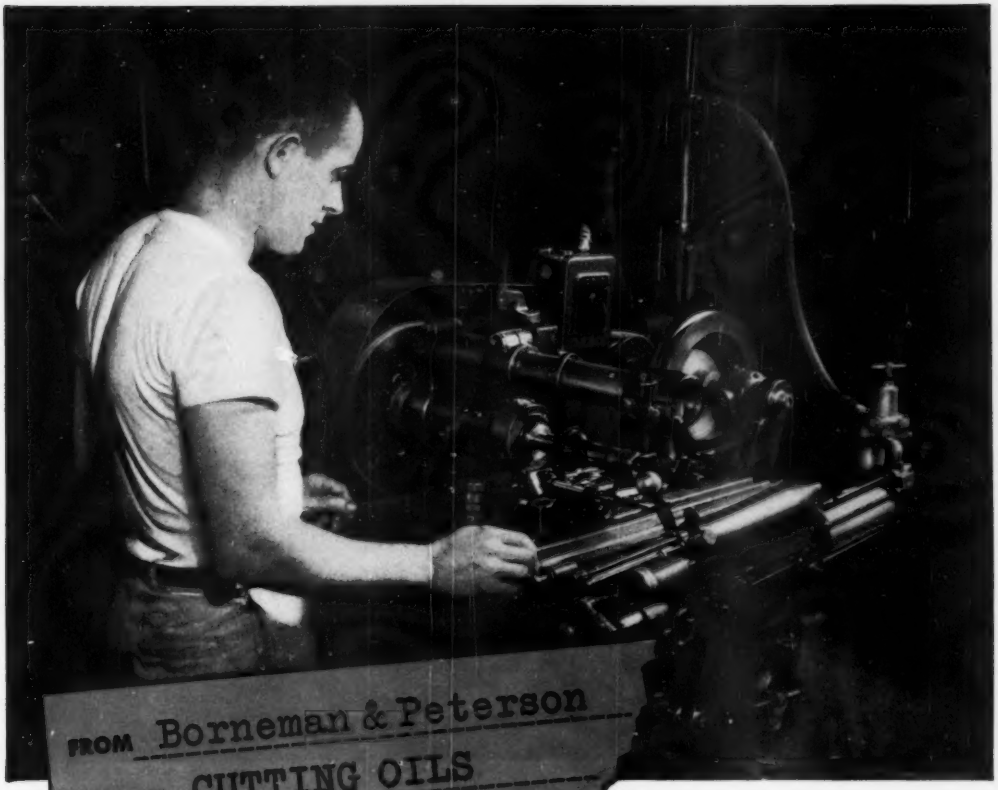
Taco West Corp, 525 N Noble St, Chicago, Ill.

For more data on these items, use post cards, p165. Identify request with P and number



ELECTRO-OILING SYSTEM

P444 • *Electro-oiling* system, Style DEI, is a single line gravity feed system, entirely automatic in operation. It consists of a central reservoir with a solenoid-operated shutoff valve and a number of individual valves mounted directly into the bearings.



ANY tiny production improvement looks big when it can be multiplied by acres of machines. But even without that—in an average size screw machine products shop like Borneman & Peterson's at Flint, Michigan—the improvement effected with Cities Service cutting oil registered impressively.

"We were getting fair results," write Borneman & Peterson, "before ever talking it over with a Cities Service Lubrication Engineer."

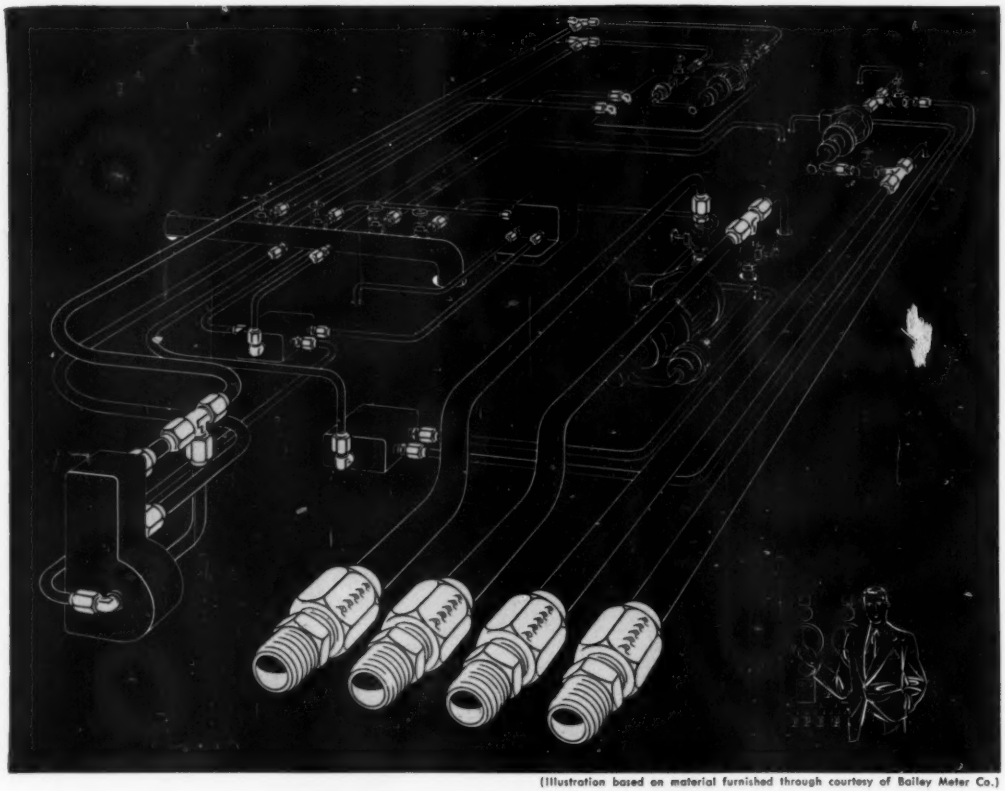
But they did talk it over, and then tried out his recommendation on a regular job of cutting ½" x 1" slots in tough tool steel. At once, the use of Cities Service Chillo cutting oil notably improved product quality.

So..."We then tried using Chillo 10 on our threading machines, and found that not only do we get a better thread, but we have increased chaser life approximately 25%."

From there on, still more uses have kept turning up in this shop for Cities Service cutting oil, simply because it distinctly pays off...as it always does when a Cities Service Lubrication Engineer offers pinpointed lubricating recommendations. He draws on the c-o-m-p-l-e-t-e Cities Service industrial line, and on deep, wide experience. You can draw on *him* by writing CITIES SERVICE OIL COMPANY, Dept. D-22, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS



(Illustration based on material furnished through courtesy of Bailey Meter Co.)

Tube it up...Forget it!

WITH PARKER TRIPLE-LOK FITTINGS

This does it

Triple-lok . . . 3-piece flare fitting famous for its sleeve . . . the easiest way to install tubing systems. Made in brass, steel, stainless steel, aluminum alloy.

Precision Mark of

Leakproof Tube Fittings

Take meter panels, for example, where delicate instruments, actuated by air, steam or other fluids, must register with optimum accuracy at all times. More and more manufacturers of precision instruments and panel boards are choosing PARKER Triple-lok Fittings to make their tubing systems *remain* leakproof throughout their long service life.

PARKER Triple-lok Fittings—as specified by the A.S.M.E. Code for Pressure Piping—are designed and precision made to be leakproof under even the severest conditions of vibration—elevated temperatures—high pressures—and repeated assembly...and to hold leakproof beyond tube bursting pressures. You will find PARKER Triple-lok Fittings not only on delicate instrument panels, but on all kinds of equipment where leakage in the tubing system would be too costly to be tolerated.

So tube it up and forget it . . . with Triple-lok Fittings. Ask your PARKER Distributor for PARKER Tube Fitting Catalog 4300, or write us direct. The PARKER Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

Parker

TUBE FITTINGS • VALVES • O-RINGS

Plants in Cleveland • Los Angeles • Eaton, Ohio • Berea, Ky.

Parker

INDUSTRIAL TUBE FITTING

STOCKS CARRIED BY

AKRON	B. W. Rogers Co. 850 So. High St.
BALTIMORE	Carey Machinery & Supply Co. 3501 Brehms Lane Whitehead Metal Products Co. 4300 E. Monument St.
BEAUMONT, Tex.	Standard Brass & Mfg. Co. 705 Milam St.
BOSTON	A. E. Borden Co., Inc. 176 Brookline Ave. Whitehead Metal Products Co. 281 Albany St.
BUFFALO	Whitehead Metal Products Co. 2128 Elmwood Ave.
CEDAR RAPIDS, Ia.	Globe Machinery & Supply Co. 309 8th Ave., S.E.
CHICAGO	Wallace Tube Co. 1300 Diversey Parkway
CINCINNATI	Williams & Co. 3231 Fredonia Ave.
CLEVELAND	W. M. Pattison Supply Co. 777 Rockwell Ave. B. W. Rogers Co. 1900 Euclid Ave. Williams & Co. 3700 Perkins Ave.
COLUMBUS, O.	Williams & Co. 851 Williams Ave.
DALLAS	Metal Goods Corp. 6211 Cedar Springs Rd.
DAVENPORT, Ia.	Globe Machinery & Supply Co. 410 East Second St.
DENVER	Metal Goods Corp. 2425 Walnut St.
DES MOINES	Globe Machinery & Supply Co. East First & Court Ave.
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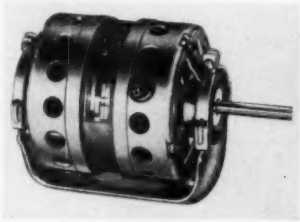
HARRISON, N. J.	Whitehead Metal Products Co. 1000 South Fourth Ave.
HOUSTON	Metal Goods Corp. 711 Milby St. Standard Brass & Mfg. Co. 2018 Franklin St.
INDIANAPOLIS	F. H. Langsenkamp Co. 229 E. South St.
KANSAS CITY, Mo.	Metal Goods Corp. 1300 Burlington Ave., N.
KNOXVILLE	Leinart Engineering Co. 412 E. 5th Ave.
LOS ANGELES	Haskel Engineering & Sup. Co. 721 W. Broadway, Glendale Metropolitan Supply Co. 353 East 2nd St.
MEMPHIS	J. E. Dilworth Co. 730 South Third St.
MILWAUKEE	Morman Belting & Supply Co. 522 W. State St. Wallace Tube Co. 838 So. 6th St.
MINNEAPOLIS	Vincent Brass & Copper Co. 100 North 2nd St.
NEW ORLEANS	Metal Goods Corp. 432 Julia St.
NEWPORT NEWS, Va.	Noland Company 27th St. & Virginia Ave.
NEW YORK	Whitehead Metal Products Co. 303 West 10th St.
NORFOLK, Va.	R. W. Hudgins & Son 3 Commerce St.
PHILADELPHIA	Louis H. Hein Co. 15 West Lancaster Ave. Ardmore Whitehead Metal Products Co. 1955 Hunting Park Ave.
PITTSBURGH	Williams & Co. 901 Pennsylvania Ave.
PORTLAND, Ore.	Hydraulic Power Equipment Co. 2316 N. W. Savier St.
ROANOKE, Va.	Noland Company 11 Salem Ave.
SAN FRANCISCO	General Machinery & Sup. Co. 1346 Folsom St.
SEATTLE	Eagle Metals Co. 4755 First Avenue South
ST. LOUIS	Metal Goods Corp. 5239 Brown Ave.
SYRACUSE	Whitehead Metal Products Co. 207 West Taylor St.
TOLEDO	Williams & Co. 650 E. Woodruff Ave.
TULSA	Metal Goods Corp. 302 North Boston
EXPORT	Mercator Corp. 438 Walnut St. Reading, Pa.
CANADA	Railway & Power Engineering Corp. Ltd. Edmonton, Hamilton, Montreal, Toronto, Vancouver, Windsor, Winnipeg

More EQUIPMENT NEWS

Begins on page 156

Copper tubing connects reservoir and all valves in series so that gravity flow will be maintained. A single reservoir will serve up to 24 bearings.

Oil-Rite Corp, 2378 Waldo Blvd, Manitowoc, Wis.



INDUCTION MOTOR

P434 • *Cyclohm* induction motor, model 3700, rated 1/25 to 1/4 hp, features a resilient mounting base, lightweight and extremely quiet operation. Hysteresis-synchronous and normal induction types in 2 pole versions, both single and polyphase are available. The near future will see 2, 4, 6 and 8 pole models including reluctance-synchronous types.

Howard Industries, Inc, Racine, Wis.

For more data on these items, use post cards, p165. Identify request with P and number.

QUICK-FILLING BURETTE

P421 • A squeeze on plastic (polyethylene) reservoir fills automatic, self-levelling burette. Streamlined, time-saver unit is now

for custom-engineered POWER

look to.. EP

Since 1909, the job of The Electric Products Company has been to create and develop special electrical rotating equipment . . . motors and generators to do existing jobs better or to reach into new fields to do jobs that couldn't be done before. The natural "by-product" of our more than 40 years of specialization is that you get equipment designed and built to the exact requirements of your application . . . equipment that has greater dependability, longer life and that requires less maintenance.

Send in the coupon below for detailed information about our Custom-Engineered synchronous motors and generators . . . d-c motors and generators . . . induction motors . . . battery chargers . . . frequency changers.

A nation-wide sales engineering and service organization stands ready to meet all User requirements.

THE ELECTRIC PRODUCTS COMPANY

1717 CLARKSTONE ROAD
CLEVELAND 12, OHIO

Attach coupon to your letterhead for your copy of Bulletin 2-200

NAME_____

TITLE_____

COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____

X-94

In a Midwestern power company ash handling installation this 8" pump shell of ABK Metal outlasted an alloy steel casting by 2½ to 1.

CUT YOUR ASH HANDLING COSTS

with ABK METAL

Its rugged resistance to abrasion means longer life — fewer replacements of parts and equipment.

For handling wet or dry ashes ABK Metal greatly lengthens the service life of ash pump casings and impellers, ash pipes, elbows and fittings, sluiceway liners, fly ash injector nozzles, wear backs and similar equipment. ABK Metal has outlasted white iron and manganese steel which it replaced, by as much as 7 to 1.

ABK Metal is a nickel-chrome iron alloy of controlled structure that will outlast and outwear any cast abrasion-resistant material under almost all conditions of service. Over a period of years it has established an unmatched record for economy and long wear under the most severe abrasive conditions.

Don't let ABRASION steal your power-economy dollars . . .

SPECIFY ABK METAL

ABK METAL fights ABRASION

AMERICAN Brake Shoe

BRAKE SHOE AND CASTINGS DIVISION
230 Park Avenue, New York 17, N. Y.

More EQUIPMENT NEWS

Begins on page 156

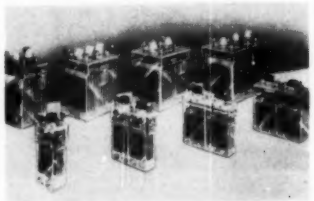
available for laboratory use. The new burette units in 25 and 10 ml sizes are graduated to tenths of a ml. They permit one-hand operation not formerly possible. **Hagan Corp, 323 Fourth Ave, Pittsburgh, Pa.**

SPLIT-CORE VOLT-AMMETER

P429 • *Amprobe* volt-ammeter measures up to 1200 amps yet can be carried in the coat pocket. Snap-around type, it measures current without being connected to conductor and without interrupting circuit.

Amprobe 1200 has six features: (1) doughnut-type transformer practically eliminates error due to position of conductor within probe jaws (2) ammeter ranges of 0-15/60/150/300/600/1200 amps ac, and voltmeter ranges of 0-150/300/600 v ac (3) self-insulating plug (4) completely insulated jaws (5) wide-angle window and (6) a length of 8½ in and a weight of 15½ oz. **Pyramid Instrument Corp, Lynbrook, N.Y.**

For more data on these items, use post cards, p165. Identify request with P and number.



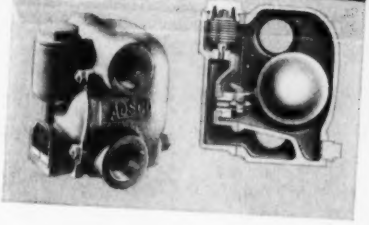
PLASTIC-CASED BATTERIES

P448 • Lightweight plastic batteries for telephone installations, alarm systems, power plant control systems and other ap-

ADSCO STORAGE HEATERS

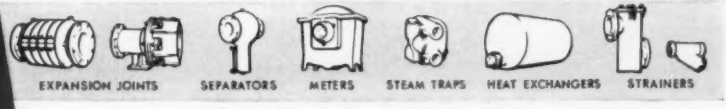
INSTANTANEOUS HEATERS

STEAM TRAPS

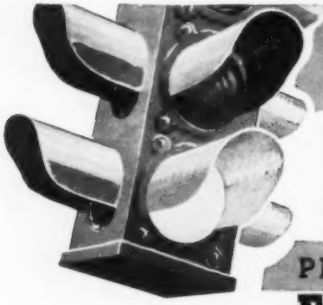


You get more than you ask for, when you buy an ADSCO storage heater . . . They are built to ASME code, whether inspection and stamping are required or not . . . Water spreader over cold-water inlet . . . Heavy rings in reinforced manhole give good gasket surfaces . . . Flange-quality steel used throughout . . . Tubes bent smooth and round . . . ADSCO heaters provide a constant, dependable source of domestic hot water and are especially suited for handling peak demands. Write for Bulletin 35-75C.

ADSCO
75 YEARS OF LEADERSHIP



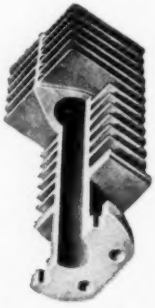
AMERICAN DISTRICT STEAM COMPANY, INC.
NORTH TONAWANDA, NEW YORK



GREEN

PREMIER DIAMOND ECONOMIZERS

Good Parts are Essential to a Good Machine . . . Let's examine a Green Fuel Economizer—Type 25—and study the major parts.



FINNED CAST ALLOY IRON TUBES WITH DIAMOND SHAPED SECTION

The diamond shape provides less restricted gas flow; easy cleaning and clearview inspection. The fins provide maximum heating surface in given space.

SEPARATE SUPPORTING AND JOINTING FLANGES

Supporting flange is separate from and independent of jointing flange. Jointing flange is not exposed to hot gases. Through bolts rather than studs are used to connect jointing flanges.

CORRECTLY PROPORTIONED, STRONG CONNECTION BENDS

These are designed to provide needed flexibility with strength. Flanges on tubes, bends and manifolds are accurately machined.

Green specially designed Soot Blower assures thorough cleaning.

Green Type 12 Premier Diamond Economizers—the Steel Tube Units—are made up of equally strong and well designed parts. Send for Bulletin No. 169.

THE GREEN *Fuel Economizer* COMPANY INC.

BEACON 3, NEW YORK

ECONOMIZERS • FANS • AIR HEATERS • CINDERTRAPS

More EQUIPMENT NEWS

Begins on page 156

plications where batteries are used for standby power. The line is available from 10 to 100 amp-hr at the 8-hr rate of discharge.

The polystyrene containers are 40% lighter than conventional containers, are smaller in overall dimensions, do not react with electrolyte, are transparent thus giving visible indication of electrolyte level, and have better shock resistance than glass containers.

Gould-National Batteries, Inc, Trenton 7, N.J.

TEFLON PACKING

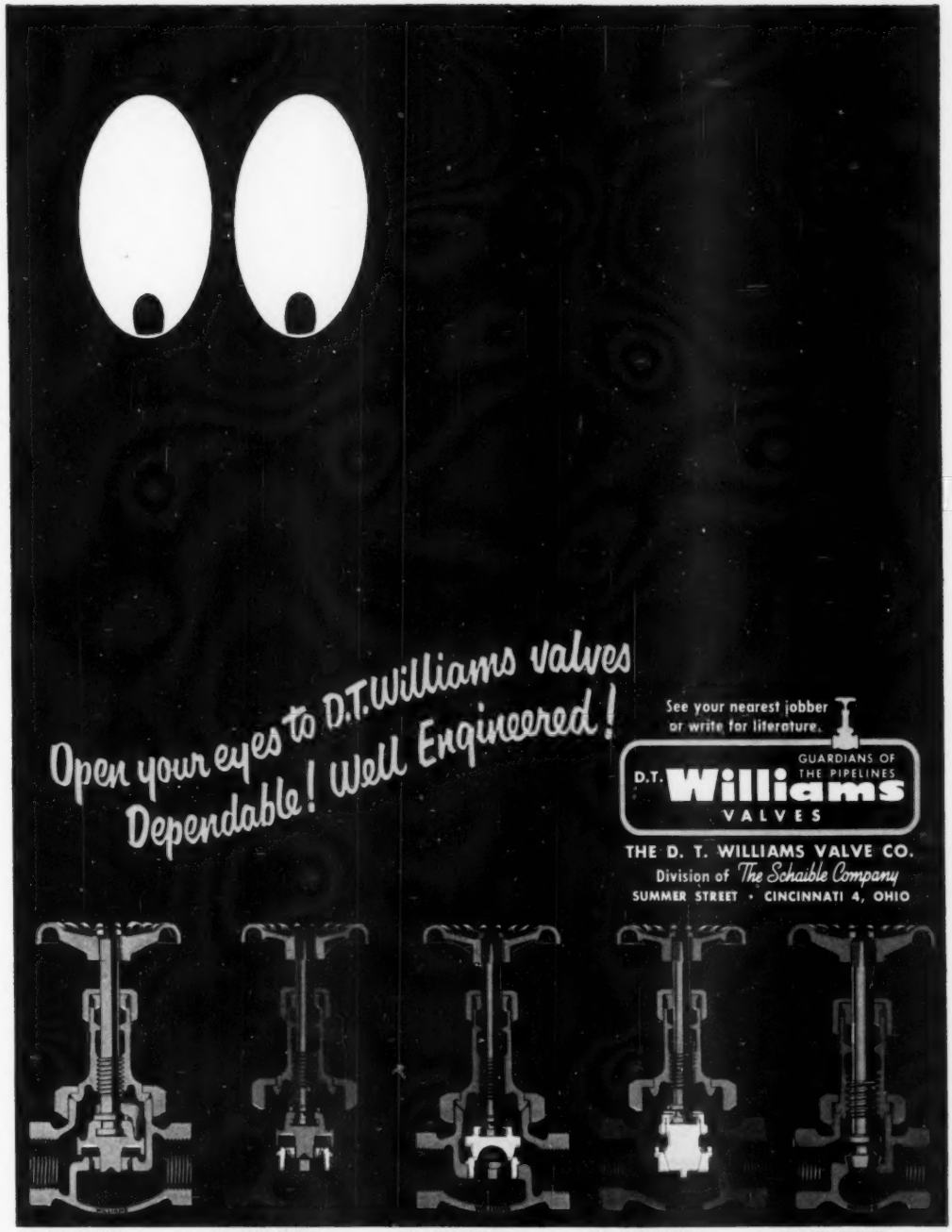
P403 • *Flexrock* No. 401 teflon-impregnated braided-asbestos packing can't be attacked by nor contanimate any industrial acid, alkali or solvent. It allows free shaft or spindle operation at all times at temperatures from −100 to +500 F. Packing is furnished in continuous lengths of square cross section in sizes from ⅛ to 1 in. by 1/16-in. increments.

Flexrock Co, Mechanical Packing Div, 3670-A Cuthbert St, Philadelphia 4, Pa.

For more data on these items, use post cards, p165. Identify request with P and number.

TWO-SCALE PYROMETER

P446 • Hand pyrometer, *Type FH-1*, with two scale ranges, is for rapid measuring of



Open your eyes to D.T. Williams valves
Dependable! Well Engineered!

See your nearest jobber or write for literature.

GUARDIANS OF THE PIPELINES
D.T. Williams VALVES

THE D. T. WILLIAMS VALVE CO.
Division of *The Schaible Company*
SUMMER STREET • CINCINNATI 4, OHIO

FIG. 912—BRONZE
"VULCODISC" GLOBE VALVE
Renewable Composition Disc • Integral Seat • Union Bonnet • Screw and Flanged Ends • 200 lbs. W.S.P., 400 lbs. W.O.G., ⅛" to 3"

FIG. 1040—BRONZE
"ELITE" GLOBE VALVE*
Renewable Composition Disc • Copper Nickel Alloy Seat • Union Bonnet • Screw and Flanged Ends • 225 lbs. W.S.P., 400 lbs. W.O.G., ⅛" to 3"

FIG. 1000—BRONZE
"ELITE" GLOBE VALVE*
Copper Nickel Alloy Renewable Full Way Disc and Regrindable Seat • Union Bonnet • Screw and Flanged Ends • 225 lbs. W.S.P., 400 lbs. W.O.G., ⅛" to 3"

FIG. 1028—BRONZE
"ELITE" GLOBE VALVE*
500 Brinell Hardness Renewable Stainless Steel Plug Disc and Stainless Steel Seat • Union Bonnet • Screw and Flanged Ends • 225 lbs. W.S.P., 400 lbs. W.O.G., ¼" to 3"

FIG. 107—BRONZE
REGRINDING GLOBE VALVE*
Renewable Bronze Disc • Integral Seat • Union Bonnet • Screw and Flanged Ends • 225 lbs. W.S.P., 400 lbs. W.O.G., ⅛" to 3"

*Available at 300 lbs. W.S.P. (Angle and check types are also available at both 200 lbs. and 300 lbs. W.S.P.)

NOW, AS ALWAYS

PABCO PRECISION MOLDED 85% MAGNESIA HEAT INSULATION

UNIFORMITY

PABCO PRECISION MOLDED INSULATIONS
APPROVED ENGINEERING SERVICE UNIT

Modern engineering demands precise standards of heat insulation performance. Pabco *Precision Molded* 85% Magnesia combines the time-tested superiority of Magnesia with precision molding to give you a light weight insulation manufactured to very close tolerances.

LIGHT WEIGHT

Pabco *Precision Molded* 85% Magnesia weighs just 11 lbs. per cubic foot. In addition to its light weight, it also brings many timely advantages, including easy application and greater rind strength.

Simpler and easier to apply! Easier to lift, cut and score. Simpler to imbed tie wires flush in the surface, too!

CLOSE TOLERANCES

Pabco's plus tolerance is only ½ *lb. per cubic foot!* This means an amazing degree of control over such factors as Weight and Thermal conductivity. Other controlled factors include size, thickness and uniform fibre distribution.

Precision pipe fit! Both pipe coverings and blocks are molded to exact final size and thickness, not molded oversize and then "milled" to size.

THE DEPENDABLE STANDARD — "MODERNIZED"

quality

PABCO PRODUCTS INC.

INSULATION DIVISION
San Francisco 19 New York 16
Manufacturers of Heat Insulation Since 1920

PABCO ENGINEERING SERVICE UNITS IN ALL PRINCIPAL CITIES

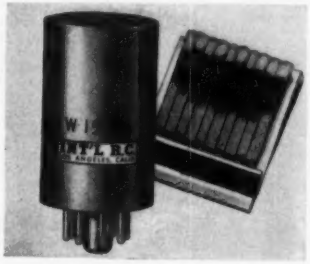
More EQUIPMENT NEWS

Begins on page 156

surface, liquid, gas and molten-metal temperatures. Ranges are 0-500 F and 0-1500 F. and the flick of a switch changes from one scale to the other.

Three interchangeable tips are available —surface, immersion (for liquids and molten metals), and two-prong contact types. Together with flexible and rigid extension arms, these tips can be easily changed.

An automatic cold-junction compensation feature eliminates the need for manual adjustment of the pointer for variations in instrument and atmosphere temperatures. **General Electric Co, Schenectady 5, N.Y.**

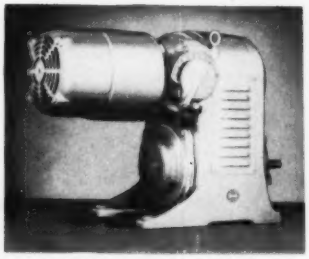


HERMETICALLY SEALED SELENIUM RECTIFIER

P443 • Metal encased and filled with inert gas, these rectifiers have standard tube terminals to fit standard sockets. All standard tube mountings are available. Unit illustrated, No. W15CM, is rated at 390-v rms input; 550-v peak inverse; 120 milliamperes, 160-v dc output at 35 C ambient. Half wave and bridge circuits are also available.

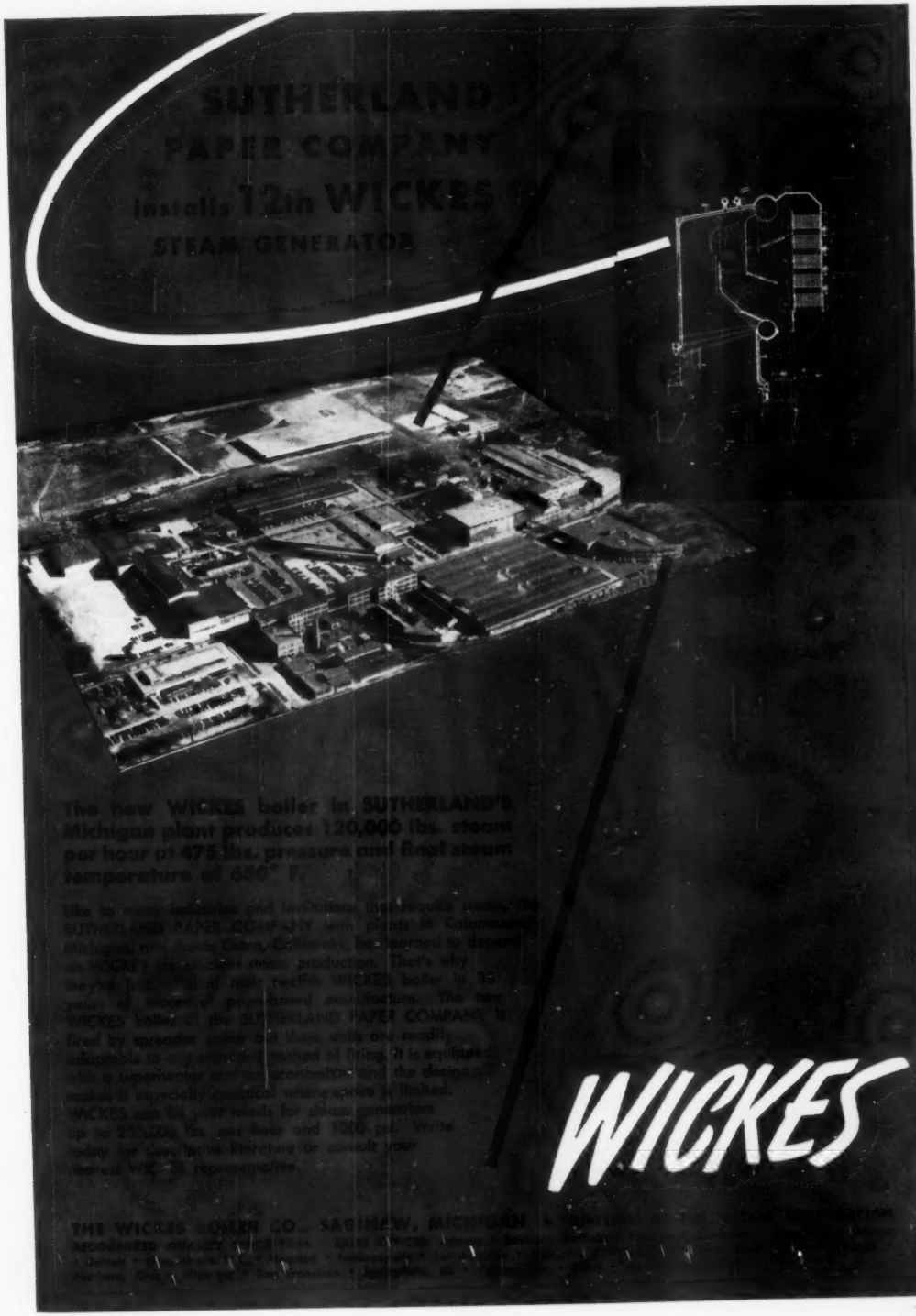
International Rectifier Corp, 1521 E Grand Ave, El Segundo, Calif.

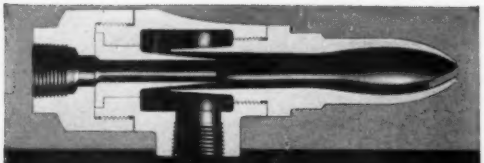
For more data on these items, use post cards, p165. Identify request with P and number.



VARIABLE-SPEED EXPLOSION-PROOF MOTOR

P441 • Rather than connecting an explosion-proof motor with a separate speed


SUTHERLAND
PAPER COMPANY
installs 12th WICKES
STEAM GENERATOR
The new WICKES boiler in SUTHERLAND'S Michigan plant produces 120,000 lbs. steam per hour at 475 lbs. pressure and final steam temperature of 650° F.
WICKES
THE WICKES BOILER CO., SAGINAW, MICHIGAN



CONTINUOUS OPERATION WITHOUT CLOGGING OR CLEANING . . .

LOW STEAM CONSUMPTION

NATIONAL AIROIL

TYPE "S-A" OIL BURNER

The popular NATIONAL AIROIL Steam Atomizing Oil Burner *thoroughly atomizes* and *completely burns* the lowest and cheapest grades of fuel oil or tar . . . requires minimum supervision and maintenance. Only slight oil pressure and temperature is needed . . . and internal atomizing venturi feature assures low steam consumption.

NATIONAL AIROIL Type "S-A" Oil Burner is adaptable to all types of industrial heating, power or process furnaces . . . is suitable for firing above stoker grates on conversion to oil.

Write for Bulletin 21.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
LOW AIR PRESSURE OIL BURNERS
FUEL OIL HEATERS
GAS BURNERS
COMBINATION GAS & OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

Main Office & Factory: 1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

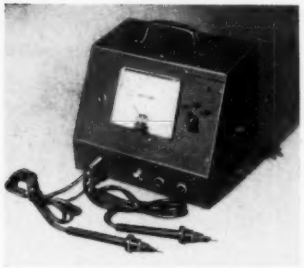
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More EQUIPMENT NEWS

Begins on page 156

changer, this unit is self-contained, all mounted in the same frame and on one base. By turning a control dial, change in speed is provided instantaneously. The motor is available in output speeds from 2 to 10,000 rpm in ratings from 1 to 20 hp. When gear reductions are necessary, they are incorporated as an integral unit of the drive.

U S Electrical Motors, Inc, 200 E Slauson Ave, Los Angeles 54, Calif.

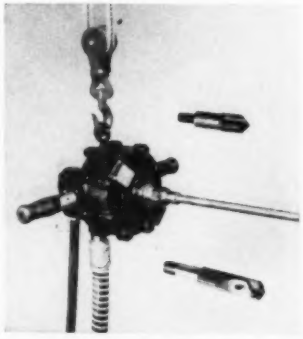


INSULATION TESTER

P440 • Safety, instantaneous indication, direct reading in megohms without calculations, ability to discriminate between a complete insulation breakdown and leakage, portability and compactness are features of this 1500-v dc insulation tester. The indicator is a direct-reading dc microammeter, is calibrated directly in megohms and will measure insulation resistance up to 1000 megohms.

Eastern Specialty Co, 3617 N 8th St, Philadelphia 40, Pa.

For more data on these items, use post cards, p165. Identify request with P and number.



CONDENSER CLEANER

P413 • Suspension-type condenser tube cleaner is designed for small, straight tube service. It has two new drill heads, special

OUR 60TH ANNIVERSARY

Your Visible Proof of Invisible Quality

Be sure it's . . .

You can't check the bronze or analyze the steel or examine the fits between mating parts of a speed reducer. But you can count on the name of the manufacturer. The name Philadelphia on a product means 60 years of experience in making power transmission equipment. It stands for a company that builds all types and sizes of speed reducing units.

The worm gear reducer shown here is just one unit of a complete line that is built from 3" to 21" gear centers in a wide variety of horizontal and vertical styles. Ratios from 3 5/8:1 to 6300:1 cover any application.

Send for our latest catalog WG-51 which shows complete details of the worm gear units. Please use your business letterhead.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

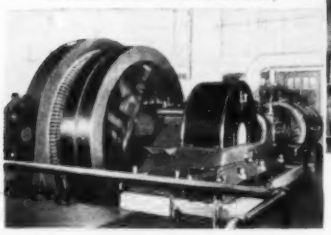
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

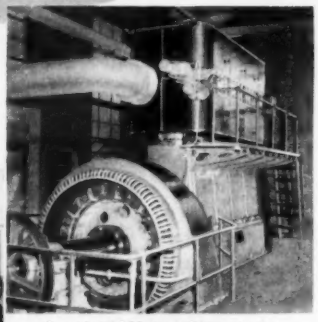
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

IN THE
WOODWORKING
INDUSTRIES

Electric Power Costs
are *Lowered* with
SKINNER
"Universal Unaflow"
STEAM ENGINES

800-Kilowatt Unit in Furniture Factory





One of six 1250-kw. A-C four-cylinder "Universal Unaflow" engines, in furniture plants of one manufacturer.

The woodworking industries are varied . . . they include manufacturers of furniture, flooring, containers, shooks, plywood, toys, and novelties. But they all need power and light. They all need steam . . . for manufacturing processes . . . for space heating.

Many of them have found an economical solution for all these needs in a single installation . . . a Skinner "Universal Unaflow" Steam Engine power plant. They have, under their own roof and under their own control, a dependable, unfailing source of power for all needs; they have ample low-pressure steam for use in their manufacturing and for space heating . . . and they are saving thousands of dollars every year over the cost of providing these needs by any other means.

Woodworking companies, together with many other manufacturers, food processors, breweries, and institutions, have been depending on Skinner Engines for four decades.

Write for case studies of what has been accomplished in industries similar to yours.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

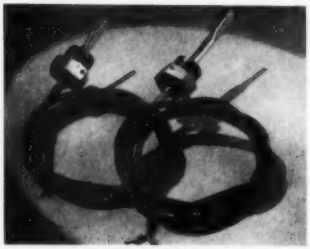
SKINNER ENGINE COMPANY, ERIE, PA.

More EQUIPMENT NEWS

Begins on page 156

heavy-duty cleaner motor, improved control system. Assembly works from an overhead support—trolley, rope-block or hanger—and gets its driving force from compressed air or electric motor. The electric motor has a trigger-controlled valve and built-in water-feeding attachment. The compressed air motor works in similar fashion through a squeeze trigger control for regulating a simple throttle valve from wide-open to shut off.

Lagonda Div, Elliott Co, Jeanette, Pa.



TEMPERATURE PICKUP

P437 • Voltage output (0-1 v) and short thermal-time constant (less than 1 sec in water) are the outstanding features of *Type 21* temperature pickup. Designed to measure temperatures up to 1000 C (1832 F), these pickups provide a resistance change of 50 ohms over their specified temperature ranges and may be excited with 20 milliamperes rms.

Type 21 temperature pickups are suited for telemetering, recording, and remote indication of liquid and gas temperatures. Their low output impedance permits voltage step-up of 10 or 20 times.

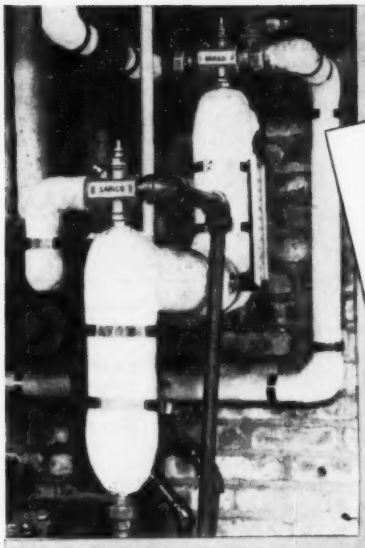
Trans-Sonics, Inc, Bedford Airport, Bedford, Mass.

For more data on these items, use post cards, p165. Identify request with P and number.

GERMANIUM RECTIFIER

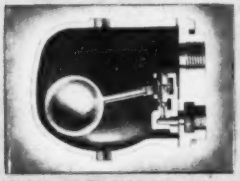
P442 • Industrial rectifiers made of germanium can operate at current densities up to 1000 times greater than existing copper-oxide or selenium stacks. Available models include those in single-phase, half-wave ratings of 12-v and 0.4 amp, 21-v and 0.4 amp, 27-v and 0.4 amp, 6-v and 6 amp. Models RA-1 and RA-2 are shown.

General Electric Co, Schenectady 5, N.Y.



Sarco makes simple, self-acting temperature controls assuring the desired Jacket cooling effect with minimum water consumption regardless of load variations.

Sarco type TR-40-L Cooling Control-Jacket water temperatures never too hot or too cold.



Sarco type FA Drain Traps have four pressure ranges to 750 psi. Sizes: ¾" or 1".

IS YOUR AIR COMPRESSOR CAPACITY EFFECTIVE?

The true measure of effective air compressor capacity is the useful work done by your compressed air.

Measured by this yardstick, many compressor installations are very much oversize for the work they do.

Apart from poorly designed piping, the trouble usually lies in wet air, overcooling, undercooling, choked intake filters, etc. All of these things add up to expensive compressed air and high maintenance costs.

New Technical Bulletin, No. 5-CA, is designed to help users and would-be users of compressed air to get more work from their machines at less cost.

Write for your free copy today.

Sarco type FA compressed air trap automatically removes separated water from the bottom of the receiver. This greatly reduces the possibility of water being carried down the distribution lines to cause trouble in the tools or at the air nozzles. This trap is also used to drain water from separators and the low points of distribution lines.

343

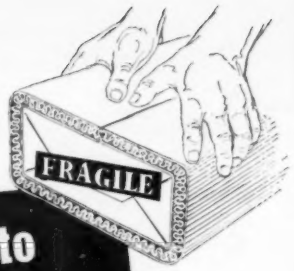
SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

Represented in Principal Cities

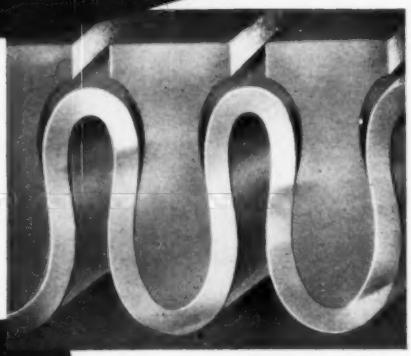
SARCO CANADA LTD., TORONTO 5, ONTARIO

a *Basic Principle* for protection



developed to ultimate efficiency

in Badger Expansion Joints

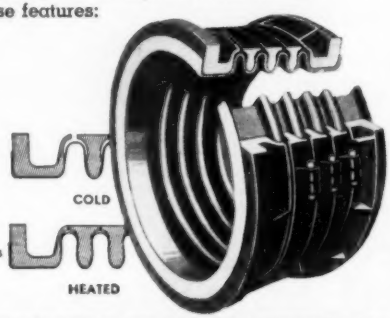


Directed-Flexing Self-Equalizing . . . exclusive features of Badger Expansion Joints

Badger Manufacturing Company developed its *Directed-Flexing, Self-Equalizing* expansion joints with lasting protection to costly equipment in mind. The all-curve pattern of the corrugated member eliminates sharp bends and structure weakening stresses which assure long maintenance-free life.

In combination with the correspondingly shaped Badger Self-Equalizing ring, progressively controlled movement of each corrugation insures a more flexible, longer lasting joint. Buy Badger Joints and you get flexibility, Directed-Flexing Self-Equalizing and these features:

- Packless . . . pressure-tight single tube— requires no maintenance
- Compact . . . approximately the size of flanged fitting
- Special forming . . . no structure-weakening stresses
- Controlled heat treating . . . assures long life
- Wide range of traverse — pressure — temperature Fabricated from deoxidized copper, stainless steel and special alloys to meet various operating conditions.



BADGER MANUFACTURING COMPANY

230 BENT STREET • CAMBRIDGE • MASS.

More TECHNICAL BRIEFS

Begins on page 152

conditions combustion may improve further. Special conditions set the optimum balance of performance. This balance may not be as easily attained with all stationary engine designs nor is it always possible with fuel on hand. *ASME paper. No. 51-A-140.*

Directions for ordering papers on p 154

Impact of Defense Activities on Petroleum. *By A K Stricker, Jr, General Motors Corp.*

If we are forced to fight another war, our requirements for petroleum products will exceed those of any past war. The Director of the Office of Defense Mobilization, in his first report, stated our objective was a capacity to build 35,000 tanks and 50,000 airplanes a year. They will all need petroleum products. The jet engine program was set at 18,000 engines a month, or 216,000 a year. War on this scale presents petroleum supply problems we have never had to meet.

Public estimates of anticipated military demands for petroleum products have been as high as 3 or 4 million barrels daily. The Petroleum Administration for Defense, staffed by men recruited from industry, has the responsibility of guiding the petroleum companies in an effort to fulfill the requirements of military services and maintain essential civilian supply. Petroleum producers are doing everything in their power to meet such requirements with a minimum of civilian dislocation. There is every reason to believe that if given freedom of action, they will realize their respective goals. *ASME paper. No. 51-A-148.*

Compressors

Wet-Compression in an Axial-Flow Compressor. *By Shao-Lee Soo, Princeton University.*

The *wet-compression* process, where a mixture of finely divided liquid water suspended in air is compressed, was originally proposed by Kleinschmidt for improving thermal efficiency and performance of gas turbine units. Wet-pressure ratio, and in this cycle no regenerator or intercooler is necessary.

In previous studies, an ideal condition of continuous saturation of air-steam mixture during compression has been assumed. This implies that either the mixture of air and water is very slowly compressed, so that equilibrium is maintained throughout, or that the diffusion rate between air and steam is infinitely large. This study correlates various factors, such as particle size,

OIC
FOUNDED 1883
THE
LONG
LINE
OF VALVES
Ford Motor Company's new foundry at Cleveland employed many OIC Valves; forged and cast steel for the power plant, iron and bronze valves for the heating and process piping.
THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO
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VALVES
FORGED AND CAST STEEL · IRON · BRONZE

ROTOJET®

Junior TUBE CLEANERS for SMALL TUBES

The new Rotojet Junior Tube Cleaner has unusual power to clean small tubes quickly. This convenient, compact, self-contained cleaner, designed for one-man operation, needs very little headroom. Tube bundles can be cleaned without removal from shell.

Roto expanding heads and brushes with replaceable wearing elements save money and assure thorough cleaning of straight and curved tubes.

Send for Bulletin J-410 for full details.

S328 ROTOJET Junior Water-driven Motor, flexible coupling, and expanding scraper

C434 ROTOJET Junior Air-driven Motor, flexible coupling, expanding brush.

S32 ROTOJET Junior Air-driven Motor, cone cutter, universal joint.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

design of compressor, etc, to obtain a better approximation to actual conditions, and to organize a theoretical basis for design and test. *ASME paper. No. 51-A-99.*

Reheat Turbines

Modern Reheat Turbines—Service Experience and Design Progress. *By C Schabtach and R Sheppard, General Electric Co.*

Simple, economical installation and operation of modern boiler-turbine reheat plants (consistent with reliability and efficiency) have been the goals of plant designers and turbine and boiler manufacturers. Experience in the recent trend to reheat confirms the soundness of this objective and the means that brought it about. The authors cite specific problems and their solution. A typical one follows.

Isolated cases of iron oxide build-up on the stems of stop and control valves have been encountered. This is most likely to occur during the first year of operation and, once the stems have been cleaned, the troublesome deposit seldom recurs. Although the source of the iron oxide is not definitely determined, the authors believe steam carries it and deposits it along the stems where throttling occurs.

Left to itself this iron oxide deposit can conceivably build up to where it shuts off flow through the restricted area. Pressure drop across the affected part reveals its presence.

More than the usual amount of valve stem sticking has occurred on new 1000 F turbines. Some of the control valve stems of the first units in the Sporn and Dunkirk stations were sticking after a few months' operation, and it was necessary to disassemble to clean the stems.

The authors observe that steam supplied to many recent reheat turbines during the start-up period was particularly rich in black iron oxide and pipe scale. In some cases the steam blowing out from the seals and drains was black. In other cases the iron oxide and scale deposited on the buckets and diaphragms, and built up as much as 3/16 in. under the bucket covers of the latter stages. This occurred only where boiler and main steam lines had not been blown down with 200 to 300 psi steam before starting. Authors strongly recommend doing this, before starting new high-temperature plants. Where it has been done results have been excellent. *ASME paper. No. 51-A-114.*

Directions for ordering papers on p 154

An Important Announcement about Lubricating Costs

Be sure with Pure

The Pure Oil Company's great new lubricants' plant near Beaumont, Texas, is now in full production.

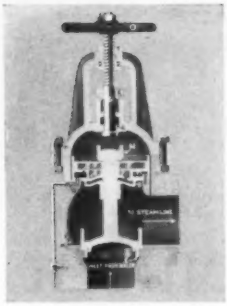
This makes Pure Oil's complete line of top-quality lubricants available to a far greater number of industrial users than it has been up to now.

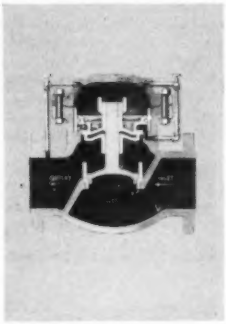
Many of these lubricants—contrary to usual practice—are designed to do several *different* jobs instead of one specific job, and to do each job *equally well.*

This enables you to do *all* your lubricating with *fewer* lubricants. In other words, you can

SIMPLIFY AND SAVE . . . WITH PURE OIL INDUSTRIAL LUBRICANTS

If this sounds worth looking into (and we assure you that it is) write: The Pure Oil Company, Industrial Sales, 35 E. Wacker Dr., Chicago 1, Ill.





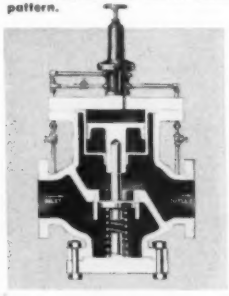
Reading from top to bottom:

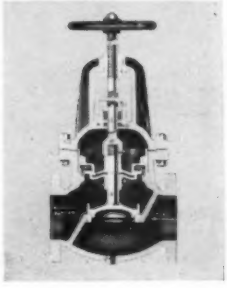
G-A double-cushioned single-acting non-return valve, angle pattern.

G-A double-cushioned check valve, globe pattern.

G-A cushioned unloading valve, globe pattern.

G-A combined throttle and automatic engine stop valve, globe pattern.

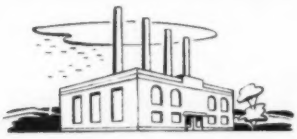




Your best

PROTECTION

against sudden shock, "hammer" and costly damage



GOLDEN-ANDERSON

Automatic

Cushioned

Steam plant

VALVES

Golden-Anderson Valves have proven efficiency, quality and dependability for over 35 years in the tough applications put to them by America's industrial and power plants. The cushioning arrangement in all G-A valves permits them to operate smoothly at all times.

Golden-Anderson designs and builds over 1500 types and sizes of valves for engineered protection and high pressure installations. Let our experienced engineers help you on your next valve problem.

IMMEDIATE SHIPMENT FROM STOCK ON MANY SIZES.

GOLDEN ANDERSON

Valve Specialty Company

2070 KEENAN BUILDING • PITTSBURGH 22, PA.

MORE POWER NEWS

Begins on page 150

COMING EVENTS

April 7-9—American Society of Lubrication Engineers, seventh annual meeting, Hotel Statler, Cleveland. J L Finkelmann, chairman, Warren Refining and Chemical Co, 750 Prospect Ave, Cleveland 15, Ohio.

April 14-18—Oil Heat Institute of America, 29th Oil Heat Exposition, Exposition Hall, Philadelphia, Pa. R H L Becher, mgr, OHI, 6 E 39th St, New York 16, N. Y.

April 15-17—American Institute of Electrical Engineers, district meeting, Jefferson Hotel, St Louis, Mo. H H Henline, secy, AIEE, 33 W 39th St, New York 18, N. Y.

April 30-May 2—American Institute of Electrical Engineers, district meeting, Arlington Hotel, Binghamton, N. Y. H H Henline, secy, AIEE, 33 W 39th St, New York 18, N. Y.

May 5-6—Second National Air Pollution Symposium, Huntington Hotel, Pasadena, Calif. Dr A M Zarem, chairman, Room 332, 612 S Flower St, Los Angeles.

May 20-21—Nuclear Energy Conference, Michigan State College, East Lansing, Mich. D J Renwick, asst prof mech engrg, chairman.

June 15-19—American Society of Mechanical Engineers, semi-annual meeting, Sheraton Gibson Hotel, Cincinnati, Ohio. O B Schier, meeting chairman, ASME, 29 W 39th St, New York 18, N. Y.

June 23-27—American Society of Mechanical Engineers, Oil and Gas Power Div, Statler Hotel, Buffalo, N. Y. O B Schier, meeting chairman, ASME, 29 W 39th St, New York 18, N. Y.

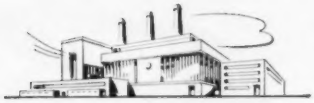
June 23-27—American Institute of Electrical Engineers, summer meeting, Nicollet Hotel, Minneapolis, Minn. H H Henline, secy, AIEE, 33 W 39th St, New York 18, N. Y.

POWER Greets Foreign Visitors

Two distinguished groups from Europe, touring American power plants under the auspices of America's Mutual Security Agency, conferred with POWER editors in the McGraw-Hill Building, 330 W 42nd St, N. Y., before starting on cross-country circuits of several weeks' duration.

On Feb 6 POWER held a round-table conference with the Austrian group of twelve men, including executives of Austrian power plants, representatives of labor, government, etc.

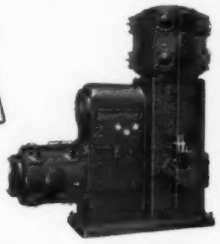
On Feb 7 the editors were luncheon hosts to a delegation of 13 engineering executives and public officials from the United King-



Here's REAL ECONOMY in AIR POWER for POWER PLANTS

Ingersoll-Rand can supply the right compressor for ALL THREE power plant applications

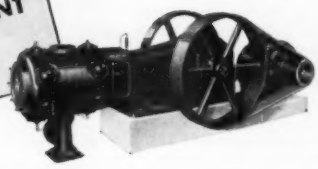
1. GENERAL SERVICE AIR



XLE Compressors

This new, compact, packaged-design, electric-driven compressor sets new standards of performance and economy in supplying general service air for power plant use. It's a heavy-duty, completely self-contained, two-stage unit producing pressures of 80 to 125 psi. The new "L" Design—with Pipeless Thru-Frame Air Flow, built-in tube-and-finned intercooler, and crankshaft-mounted synchronous motor—saves floor space, cuts installation cost and reduces maintenance.

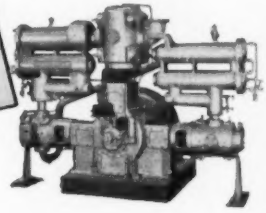
2. INSTRUMENT AIR



ES-NL Compressors

The famous I-R Class ES compressor—with NL (non lubricated) cylinder—is the most dependable and efficient source of oil-free air for operating pneumatic control instruments. The heavy-duty ES compressor meets the most exacting requirements for instrument air systems, where dependability and continuity of service are essential. The NL cylinder is fitted with graphitic carbon supporting and pressure rings, requiring no oil, grease, water, or glycerine for lubrication.

3. SOOT BLOWING



TVH Compressors

This three-stage compressor, with discharge pressures of 350 to 500 psi, has been especially developed for heavy-duty soot-blowing service. Inverted "T" design, with self-contained interstage cooling, assures high over-all efficiency, low discharge temperatures, and smooth running balance. Floor space requirements are reduced and easy accessibility of all parts simplifies inspection and maintenance. Available with direct-connected motor drive.

694-1

● All of these compressors have one thing in common—Ingersoll-Rand's traditional dependability and performance. That's your best assurance of minimum operating and maintenance expense, with important long-term savings that mean real economy in air power equipment. Your nearest I-R representative will be glad to give you complete information on the compressors best suited to your needs.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

TWO STAGE—DOUBLE ADJUSTMENT

Crusher is pictured without hopper and sprocket guards, but is delivered complete.

WRITE TODAY FOR CRUSHER BULLETIN P-2

Two Stage CRUSHING IN ONE MACHINE!

Fulfilling an urgent need in the industry, the GUNDLACH "Two Stage" Crusher has delivered over 85% usable stoker coal from an Illinois mine run lot.

The GUNDLACH "Two Stage" Coal Crusher incorporates two crushing stages in one machine and is designed to reduce RUN-OF-MINE to STOKER COAL in ONE operation. Compact design simplifies structural supports and installation. Rugged simple construction combined with engineering proved in the field makes this machine a profitable and reliable unit.

MATERIAL SIZE CAN BE CHANGED WHILE MACHINE IS RUNNING

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578540)

T. J. GUNDLACH Machine Co., Belleville, Ill.

More POWER NEWS

Begins on page 150

dom. The British team then started an American tour of several weeks' duration to study methods of saving fuel, a most vital problem in England right now because of their shortage of coal.

In an extended conference with the editors after the luncheon, much information was developed to help guide the visitors toward their ultimate assignment—proposal of a new fuel policy for the British government.

Cathodic Protection of Underground Steel

Underground corrosion of steel pipe costs an estimated $600 million annually in the U. S. Efforts to reduce this toll have been stimulated since 1941 by heavy defense requirements for steel and other metals. Workers in the field have learned that underground corrosion can be greatly reduced by cathodic protection where the structure is maintained at a suitable negative electrical potential.

A recent study by W J Schwerdtfeger and O N McDorman of the National Bureau of Standards corrosion laboratory shows the mechanism of this important means of inhibiting underground corrosion. They determined the optimum potential for effective protection. By eliminating uncertainties inherent in field measurements, NBS fixed this optimum on a firm scientific basis. They confirmed the value arrived at—minus 0.77 volt referred to a saturated calomel electrode—by weight-loss measurements on electrodes maintained at the selected potential in five corrosive soils.

To arrive at the optimum protective potential for steel in soils, NBS measured the potentials of steel electrodes in 20 air-free soils, ranging from very acid (pH 2.9) to very alkaline (pH 9.6). They plotted potentials against the pH values of the soils. The resulting curve intersected the potential curve for the standard hydrogen electrode at a pH of approximately 9 and a potential of -0.77 volt (referred to a saturated calomel electrode). This potential was also approximately the most negative value measured. At more negative potentials iron becomes cathodic to the hydrogen electrode and corrosion therefore ceases.

The second integrated test run of the new **Bureau of Mines** gas-synthesis demonstration plant at Louisiana, Mo., was successfully completed recently. Lasting for 25 days, this run marked a milestone in a program of technologic and scientific research that has greatly improved a German technique for producing gasoline and other liquid fuels from coal and adapted it to American conditions. The plant was started Oct 23, after making changes shown to be desirable by the initial eight-day shakedown run that ended Sept 12. By Nov 23, when a routine shutdown was made, enough raw gasoline and diesel fuel had been produced to permit later final refining of these products to meet specifications.

It's "CORNY"

...but it's the best way to CLEAN motors, generators, turbines!

PANGBORN AC-4 Blast Machine

- CUTS DOWN-TIME
- CLEANS WITHOUT SOLVENTS
- ELIMINATES DRYING
- ELIMINATES TOXIC AND EXPLOSIVE DANGERS

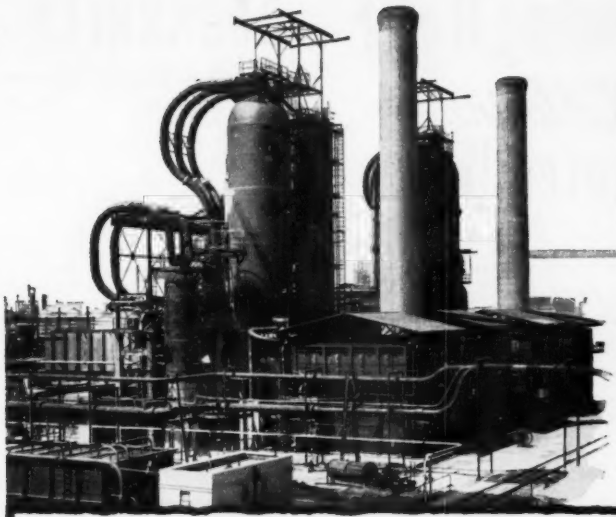
THE new Pangborn AC-4 Blast Machine cleans motors, generators and turbines faster . . . cleaner . . . and lets you use them sooner because there's no waiting for parts to dry. In fact, dangerous solvents that can lead to explosions, caustic action, and toxic poisoning are completely eliminated!

The AC-4 uses soft, 20-mesh corncob grits to rapidly remove dirt, grease, old paint, etc., in one-third the time, and at 90% less cost than old-fashioned methods. GET FULL DETAILS . . . write, telling us what you clean, to: PANGBORN CORP., 90 Pangborn Boulevard, Hagerstown, Md.

Look to Pangborn for the latest developments in Blast Cleaning and Dust Control equipment

Pangborn

BLAST CLEANS CHEAPER with the right equipment for every job



Carey INSULATION is at work for GULF . . .

keeping process and steam lines operating at lowest cost

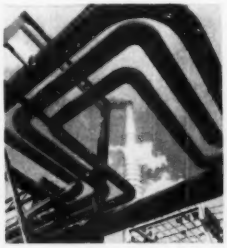
Refinery men demand *quality* insulation for processing operations. It's needed to keep fluids at constant temperatures. Helps cut fuel waste.

Since 1929, Carey insulation has been in continuous service at the Port Arthur, Texas plant of the Gulf Oil Corporation. Over the years, it has proven itself equal to the punishing strains of vibration and rapid expansion and contraction of equipment encountered in refinery operations . . . while guarding against heat loss, holding the line on costs!

In *your* plant, you'll find dozens of applications where a Carey insulation material can conserve heat, save fuel. Carey's complete line of high and low temperature insulations includes blocks, blankets, pipe wrapping and jackets, cements and new Super-Light 85% magnesia in precision-sized blocks and nesting "O.D." pipe coverings that are easy and economical to apply.

Whether your problem is one of insulating "straight runs" or complicated shapes, a Carey Industrial Sales Engineer can show you why Carey insulation is best for the job. He'll gladly furnish you with complete technical and application data. No obligation to you. Telephone, wire or write our nearest office today.

Another Carey product—Careystone Corrugated Asbestos-Cement Roofing and Siding—protects Gulf Oil Corporation's warehouse at Port Arthur, Texas. This material is absolutely impervious to corrosion, rust, rot, decay; never requires painting or preservative treatment; is virtually maintenance-free!



"Worm's eye" view of live and exhaust steam lines insulated with Carey materials. Besides the usual hazards of expansion, contraction and vibration, this Carey installation stands up under the extremely hot, humid weather of the Gulf area.

Carey insulation materials have weathered 23 years of continuous service on the fractionating tower and vapor lines of these atmospheric and vacuum stills at Gulf Oil Corporation's Port Arthur, Texas plant.

Write Today for Your FREE Copy

of "Industrial Insulation." Tells all about Carey insulations, and how to select and use them. A copy is yours for the asking.

FROM THE HOUSE OF CAREY—
Industrial Insulations • Careystone Corrugated Roofing and Siding • Built-up Roofing • Careyduct • Asphalt Plank • Asphalt Paints and Coatings • Industrial Flooring • Other Famous Products for Industry Since 1873

Carey

The Philip Carey Mfg. Company, Lockland, Cincinnati 15, Ohio • In Canada: The Philip Carey Co., Ltd., 277 Duke St., Montreal 3, P. Q.

Treat Cooling Water *with Chlorine* — the Proven Way

HELP MAINTAIN MAXIMUM PLANT EFFICIENCY..

Hundreds of power plants and refineries have found chlorination by W&T the answer to heat exchanger slime problems. By eliminating slime forming microorganisms, maximum heat transfer is maintained in the condensers. The result — overall plant efficiency is kept at a maximum.

REDUCE LABOR COSTS...

High labor costs involved in frequent condenser tube cleaning are eliminated when chlorination is employed. Manhours used for tube cleaning can be utilized for other maintenance jobs, an important factor with the increasing manpower shortage.

REDUCE DOWN TIME...

Elimination of frequent shut-down for tube cleaning helps power plants stay continuously "on the line." When chlorination is employed, many plants find that outage for cleaning is reduced to once per year and then only for removing trash from tube sheets.

W & T Air Operated Visible Vacuum Chlorinator

Years of operation have proved the dependability and accuracy of W&T Chlorinators for cooling water treatment. Low maintenance and automatic program operation keep operating costs to a minimum. For information on how you can solve your slime problems, contact your nearest W&T Representative or write to:

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

BOOKSHELF

Industrial Piping *(1951). By Charles T Littleton, formerly engr in charge of piping, American Cyanamid Co. Special chapter on estimating by R A Dickson. 394 pp, 6¼ x 9¼ in., many illust and tables, cloth, $8. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y.*

Few piping reference books contain only that information needed by practicing designers, erection foremen and engineering students. This book was written to fill that need. No attempt is made to expound theories of hydraulics, thermal expansion and radiation. On the other hand, practical methods commonly used for sizing pipes and finding pressure drop are presented. User of book need know only algebra and elementary physics.

Chapters cover flow sheets, plot plans, design procedure, steam, water, gas, air, oil and instrument piping, valves, alloys and miscellaneous piping materials, insulation and piping cost estimation. Much information on each of these subjects is included.

Special chapter on cost estimating should be of great use to plant designers. By application of suitable factors basic cost data given can be translated into today's prices for accurate estimates.

This is a book that will be a big help to all engineers who work with piping on their daily jobs. It saves time and labor.

Electrical Engineering *(6th edition). By Clarence V Christie, Consulting Engineer, Prof of Electrical Engineering, McGill University, Montreal, Canada. 675 pp, 6½ x 9 in., $7. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N.Y.*

Fundamental approach to complex problems in electrical engineering is retained in this edition. Basic aim was to prepare and encourage the student to extend his studies into more advanced phases.

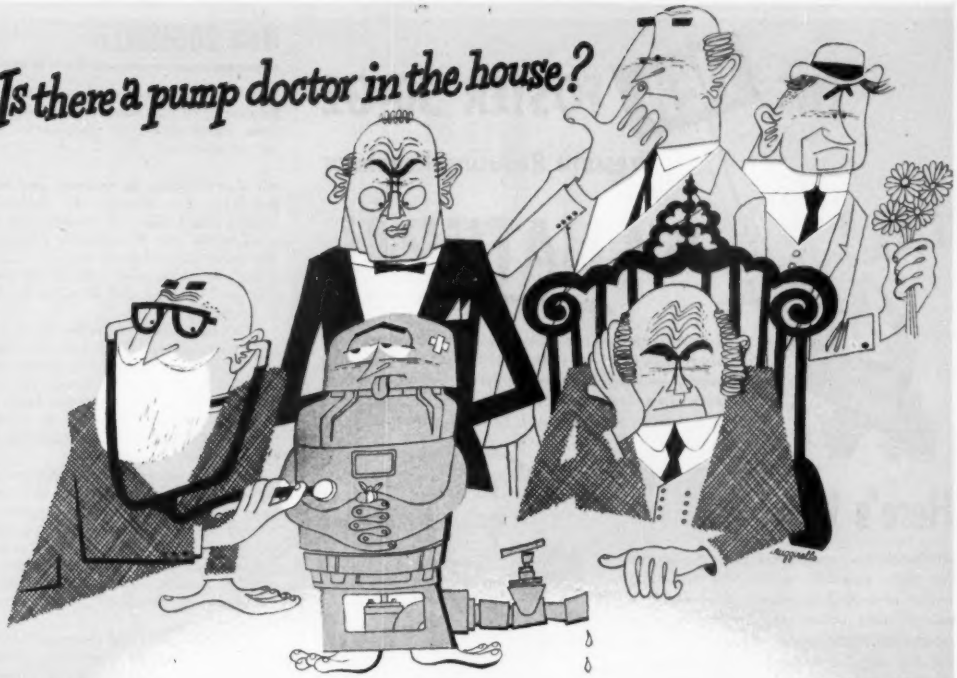
The author presents a rather complete coverage of electric circuits, complex ac waves, design of dc machinery, synchronous machines, transformers, converters, motors and finally transmission systems. The theoretical rather than the practical side of the picture is stressed throughout.

Introduction to Lighting *By Howard M Sharp, Asst Prof of Engineering, University of Buffalo. 337 pp, 6 x 8½ in., $6.65. Prentice-Hall Inc, 70 Fifth Ave, New York 11, N.Y.*

Production, control and measurement of light as a scientific tool is the foundation chosen by the author. From there the reader moves to the application of fundamentals to the workable solutions of everyday lighting problems.

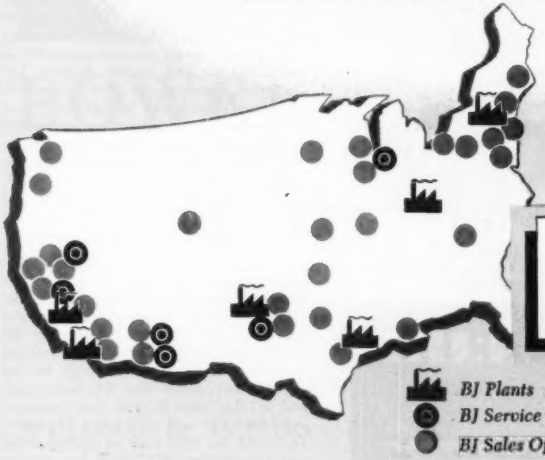
The book is slanted for the practical man rather than the pure theorist. Although the material is suitable for a formal college course, portions of it may be utilized for industry training programs.

After covering the basic concepts the author discusses electric lamps, ballasts, transformers and starters, and then the control of light. The questions of absorption,



YES... THERE'S A BJ PUMP SPECIALIST A FEW MILES OR MINUTES FROM YOU!

If you have a sick pump—or if you're having trouble diagnosing a pumping problem, a BJ pump specialist can help. These fully-qualified BJ Sales Engineers, working out of 31 *company* sales offices, bring you the benefit of BJ's 80 years' experience in meeting and solving every kind of pumping problem. These local Byron Jackson offices are in addition to BJ's six modern factories, six service shops, and reliable dealers. For pump engineering assistance and quick answers to your particular pumping problems, just phone your nearby BJ Branch Sales Office!



Byron Jackson pump manufacturing plants are located in Los Angeles and Fresno, Calif.; Houston and Plainview, Tex.; Lawrenceburg, Ind.; and Bethlehem, Penn.

In addition, BJ Service Shops are operated in Chicago Heights, Ill.; Chico and Lodi, Calif.; Casa Grande and Phoenix, Ariz., and Lubbock, Tex.

BJ

Byron Jackson Co.

Since 1872

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Offices in Principal Cities

THE NEW FOSTER 50-G2

Pressure Reducing Regulator

IS A NATURAL

It combines extremely close regulation and high inlet-to-outlet ratio, under varying loads — approaching *instrument control* — with the freedom from trouble, long life and easy maintenance of a *regulator*.

Here's Why:

Although the new 50-G2 is single-seated for tight shut-off, it has the throttling action of a double-seated valve. Full balanced pilot valve and short travel of operating steam to the main valve piston cut the lag in response, for extremely close following of the demand. Yet overtravel, flutter and chatter are eliminated by the mass of the piston, stabilizing multi-rings, and unrestricted area under the piston.

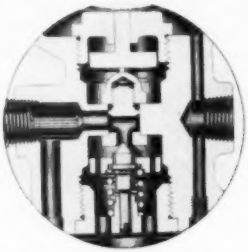
Pilot valve opening *with* the flow minimizes deadhead loss, and permits higher inlet-to-outlet ratio, for instance, 250# to 2#. May eliminate intermediate stage in low pressure applications such as deaerating water heaters, tank storage heaters and auxiliary exhaust systems.

All wearing parts are of stainless, corrosion and erosion resisting materials. New alloy metals mean less wear.

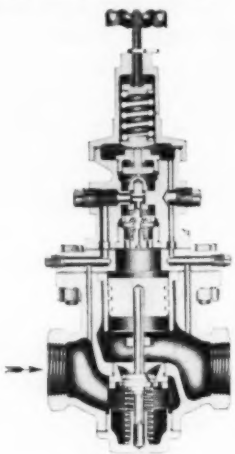
No special tools are needed servicing, and no outside media are required for operation.

Available for initial pressures 25—1200 P.S.I.G.; temperatures to 950°F; reduced pressures from controlled vacuum of 15" HG. to 600 P.S.I.G. with minor changes in top assembly; sizes ½" to 12"

For full information, ask for Bulletin G-101.



50-G2 Auxiliary or Pilot Valve Unit



Foster Type 50-G2 Internal Pilot Operated Pressure Reducing Regulator with Standard Top Assembly

FOSTER ENGINEERING

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . CUSHION CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SIRENS . . . SAFETY VALVES . . . FLOW TUBES

More BOOKSHELF

Begins on page 196

reflection, transmission, effect of angle of incidence, color, characteristics of materials, interpretation of photometric data etc are discussed.

Air Conditioning in Summer and Winter *(1951—2nd edition). By Richard E Holmes, chief engr, air conditioning and refrigeration div, Worthington Pump and Machinery Corp, 352 pp, 6¼x9¼ in., 140 illust, 47 tables, cloth. $5.75. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N.Y.*

This clear, practical book gives a step-by-step explanation of principles and methods of air conditioning. Equipment construction and operating details are fully described. Men who study this book will obtain a thorough grounding in information essential to planning, installation and upkeep of efficient systems.

First part discusses psychrometric principles, physiology of comfort and other basic subjects. A number of chapters are devoted to summer air conditioning and a number to winter conditioning. Temperature and humidity controls are covered in the last chapter. Commercially available equipment is described and illustrated throughout.

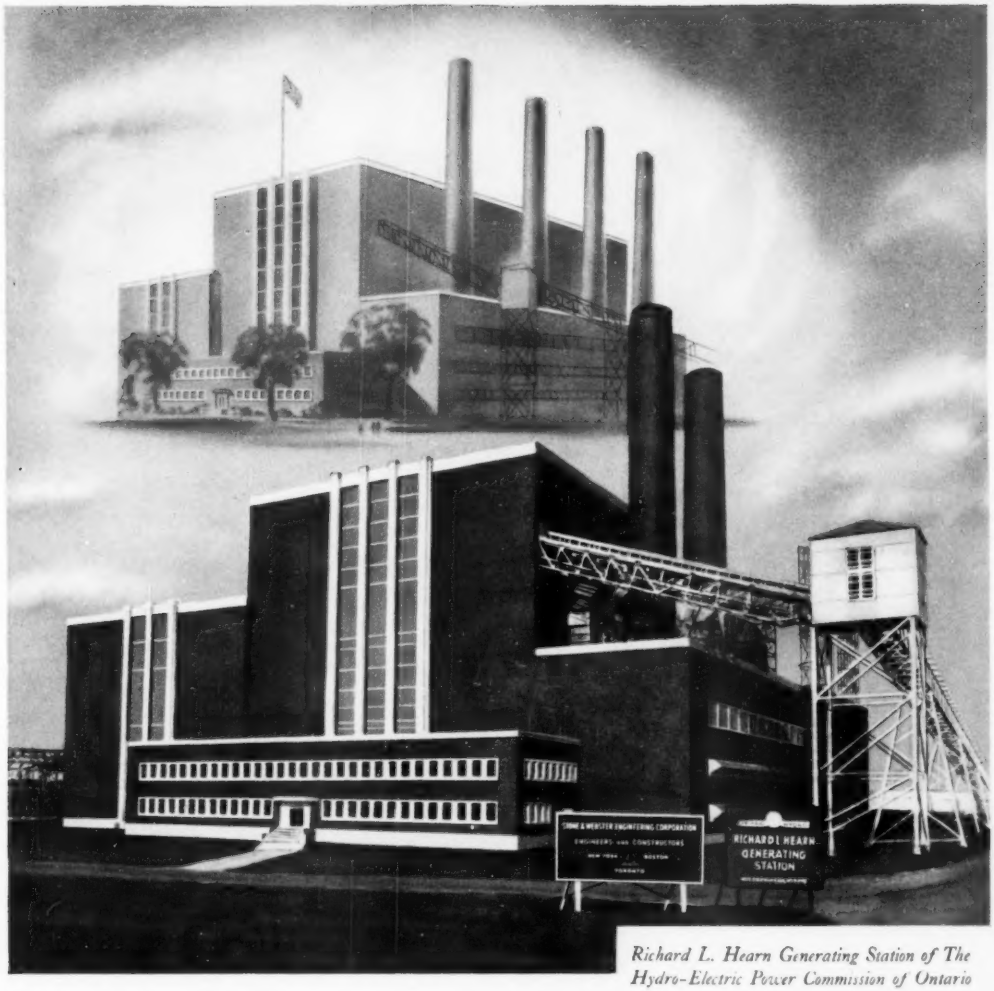
This edition gives new and more information on heat pumps, absorption systems, water chillers, electrostatic air cleaners, reciprocating and centrifugal compressors, low-side equipment, panel-heating systems, packaged air conditioners, dehumidifiers and other units.

How to Convert to LP-Gas Carburetion. *(1951) By T E Wisby, Director of Training, in collaboration with the National LP-Gas Institute. 419 pp plus index, illust. $10. Ross-Martin Co, Box 800, Tulsa 1, Okla.*

Growing use of liquefied petroleum gas (LPG or LP-gas) in many areas makes this book on its application as a fuel for internal-combustion engines timely. In a practical way, the author gives a great deal of useful information on engines in general and on the specific steps involved in using LPG as fuel. Emphasis, quite naturally, is on automotive and tractor engines, but smaller industrial engines are also discussed.

Engineers interested in LPG will find the chapter on its properties particularly useful. Other chapters of exceptional interest deal with regulations governing use of LPG carburetion and with trouble-shooting. A series of appendices describe and give engineering data on the various types of LPG carburetion equipment available.

Industrial gas equipment division of the **Gas Appliance Manufacturers Assn,** described as unprecedented the demand and opportunity for graduate engineers in the gas heat-processing field. The fact that gas equipment usually is custom-built for the ultimate user, means that the young engineer is called upon for both basic engineering knowledge and on-the-spot ingenuity. The need for this kind of ability never was greater than in today's rearmament program, it is claimed.



Richard L. Hearn Generating Station of The Hydro-Electric Power Commission of Ontario

POWER
FOR ONTARIO AND CANADA'S FUTURE..

Designed and being constructed by Stone & Webster Engineering Corporation, this steam electric generating station on Toronto Harbor will supplement existing hydroelectric generating capacity to meet the demands of the fast-growing Province of Ontario.

Planned for an initial installation of 400,000 kw, it is expected that its ultimate capacity will be 600,000 kw.

STONE & WEBSTER ENGINEERING CORPORATION

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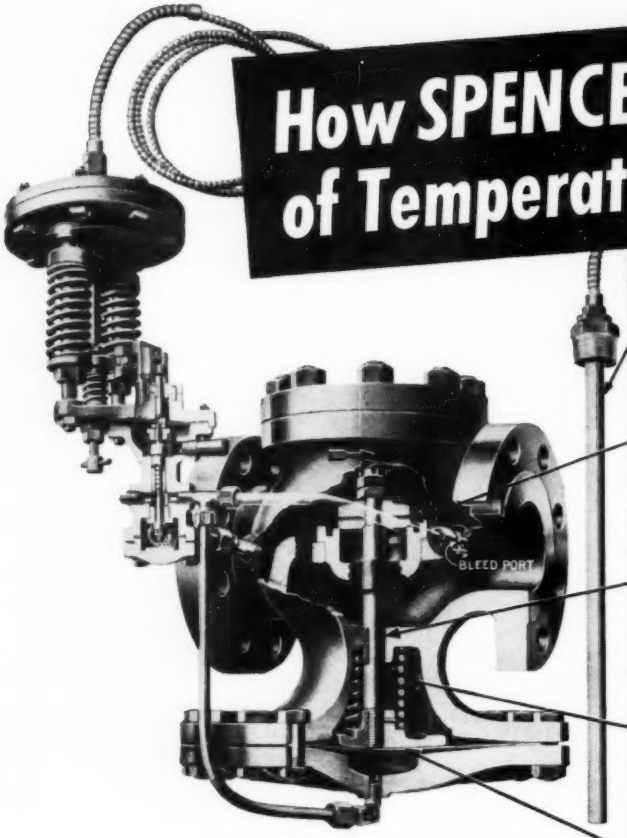
How SPENCE Cuts Costs of Temperature Control



NEW THERMOSTAT ELEMENT—Improved to practically eliminate loss of filling. Rugged construction; cannot be injured by overheating.

SECO METAL—Seats and discs are made of SECO Metal—guaranteed not to wire-draw.

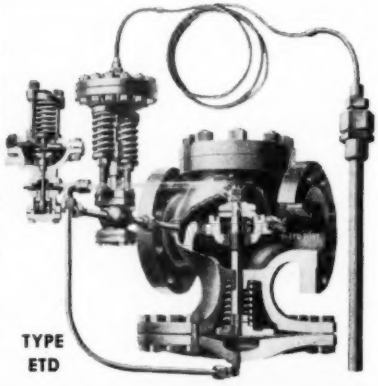
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

PROTECTED SPRINGS — Springs in the Spence Regulator are out of the path of the steam or other fluid flowing through the valve.

LARGE BALANCED DIAPHRAGM— Spence metal diaphragms, under usual conditions, never require replacement.

Accurate Control for Both Storage and Instantaneous Heaters

Spence Temperature Regulators reduce the steam pressure and also accurately modulate the flow as required to control the temperature. No separate reducing valve is necessary • The Spence ET150 Regulator is recommended for heater pressures up to 50 psi. For higher pressures the Type ETD is available • For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200.



TYPE ETD

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Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

SAW CONCRETE ....

OR ASPHALT

with CLIPPER CONCRETE SAWS

THIS FAST-EASY ECONOMICAL WAY!

NOW SAW . . . BEFORE BREAKING! On patches and trenches the removal costs are reduced more than 25% and replacement material is poured to straight, smooth edges. A sawed cut made ¼ the slab depth provides a perfect plane of weakness for fast breaking and removal.

Patches...

Eliminate spalling and fractures around repair patches by sawing before breaking. Saw clean, straight lines, break smooth, then patch perfectly in building floors, runways, drives, etc.

Trenches...

Gas, Water, Electric, Sewer, Telephone . . . wherever new lines are installed or old ones repaired. Saw trenches . . . any width . . . then break out to straight, smooth edges — no fractures beyond removal lines.

Contraction Joints...

Saw contraction joints in continuously poured slabs and eliminate costly hand forming and usual spalling. Building floors, highways, streets, runways, walks, etc. can all be sawed.

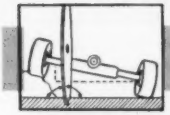
MODEL C-130

One of FIVE MODELS
Gas or Electric Power

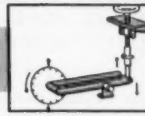
Free Trial...

You can TEST—actually TRY a Clipper Concrete Saw on YOUR Job without obligation! Write for details! . . . by the Originators of Masonry Saws.

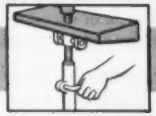
MAXIMUM ECONOMY IN CONCRETE CUTTING ONLY POSSIBLE WITH THESE EXCLUSIVE CLIPPER FEATURES



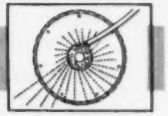
1. Clipper "No Bind" Floating Three Point Suspension Automatically protects blade



2. Positive Screw Feed Instant control raises or lowers blade smooth, easy



3. Adjustable Depth Lock Set this handy stop for whatever depth desired.



4. Patented Spray Control Its value is measured in increased Blade Life.

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(YOU CAN USE ONE OVER AND OVER AGAIN)

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Here's why you can get so much work out of a Dart:

- ***Drop-Tight Yet "Easy Does It"***
  Dart's spherically ground seats provide a wide, full bearing surface that requires a minimum of nut take up. Excessive wrenching (hard on metal and man) isn't required. What's more, a Dart *stays* tight.

- ***Non-Corrosive Bronze Seats***
  Why do they use bronze for memorial plaques? Because it *lasts!* That's why *we* use this non-corrosive metal for protection of seats against pitting and corrosion.

- ***Practically Indestructible Nut and Ends***
  Air refined malleable iron is tops for resistance to stress, stretching and wrenching. That's why we use it for Dart nuts and ends.

Test a Dart on your next job. You'll *like* its quicker, easier action — you'll *save* by its longer working life!

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DART
UNIONS

MARMADUKE

Continued from page 144

"Not wishing to hurt anyone's feelings by saying what I thought of that setup, I says in a casual way to Tuffy Smith, the hard-boiled master mechanic, 'What knuckle head is responsible for this would-be powerhouse?'

"'I laid out this plant and I'll lay out any guy who makes any cracks about it,' yells Tuffy, sticking out his chin.

"'Look, mister, I'll just get busy on that throttle and try not to look at anything in here that'll give me a nightmare—until I get a pay check,' I informed him in a diplomatic way. 'But once I have folding money again to travel with, I'll teach you the A B C's of plant layout in one easy lesson.'

"That hoist was a sweetheart and before long I was hoisting and dumping like an old-timer. But I couldn't keep my eyes off that engine room. For one thing, I noticed the firemen carried the water level too high and the boilers foamed badly.

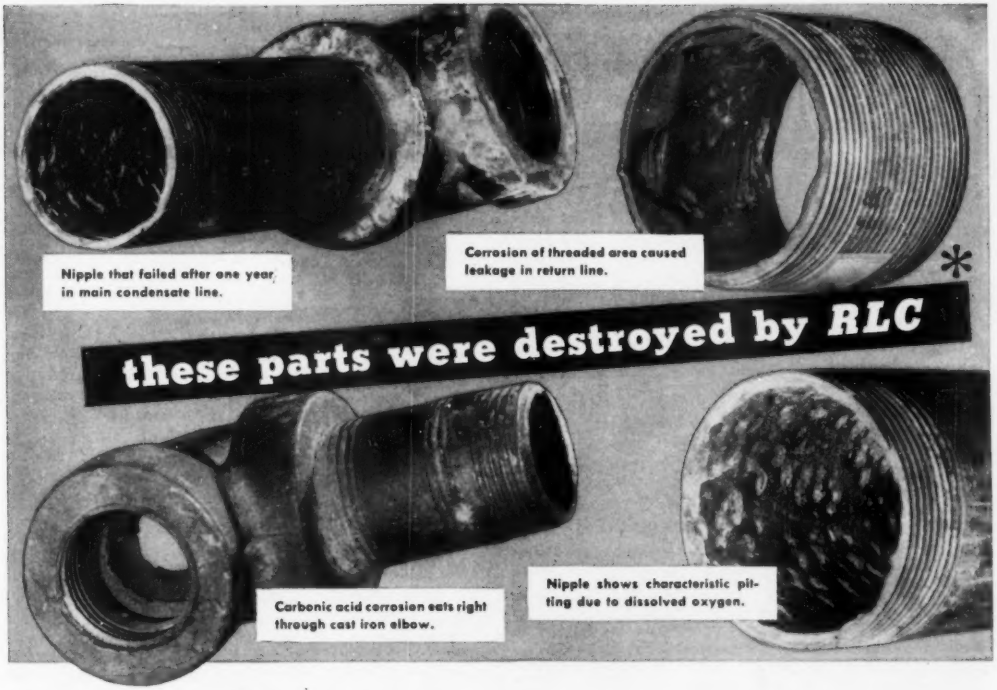
"With all that foaming and because the header had no drain, I had to work a barrel of water through the throttle each time I opened her before getting steam.

"Because I babied the hoist, the water didn't hurt it, but a new 14x14 horizontal steam engine next to the throttle sure took a beating. She'd get a slug of water and then rattle and vibrate like an ocean-going ship with her engines suddenly put full astern. But only trouble that water treatment caused was to break her piston rings into little pieces.

"So every second day or so Tuffy and his boys had a regular job of yanking off her cylinder head, pulling the piston and installing new rings. I decided to keep my mouth shut and stick around to see just how long that engine could stand that kind of punishment.

"A week later Tuffy announced he would solve the ring problem once and for all. To get properly inspired, he burned the midnight oil that evening far into the night, down the road at McGillicuddy's Tavern. After a lot of elbow bending he finally came up with a solution that was a knockout—and I mean a knockout. I naturally expected to see a few drain lines and traps put in, because that's all he needed. But I didn't know Tuffy.

"What was his solution?" asked Marmaduke, shaking his head sadly. "WHY, HE HAD HEAVIER PISTON RINGS MADE. The new quarter-inch-thicker rings were put into the grooves without measuring their groove depth to see if they fitted. Instead, Tuffy and his boys shoved the piston into the cylinder. The rings got


Nipple that failed after one year in main condensate line.
Corrosion of threaded area caused leakage in return line.
these parts were destroyed by RLC
Carbonic acid corrosion eats right through cast iron elbow.
Nipple shows characteristic pitting due to dissolved oxygen.

prevent Return Line Corrosion with Dearborn Formula 700 or 702

These destroyed parts were the victims of *return line corrosion.* If your maintenance costs are high because leaking or clogged return lines require replacement—if rusty condensate is coming back to your boilers—then it will pay you to use Dearborn Formula 700 or 702.

Return line corrosion is caused by oxygen and carbon dioxide. It can be effectively controlled thru the easy, inexpensive application of either the neutralizing amine-type treatment (Formula 700) or Dearborn's new filming-type amine treatment (Formula 702).

Your Dearborn Engineer is prepared to make specific recommendations on the use of Dearborn Formula 700 or 702 in your plant.

DEARBORN CHEMICAL COMPANY
Merchandise Mart Plaza • Chicago 54, Illinois

WRITE FOR THIS BULLETIN

Write for Bulletin 5013 which outlines causes of return line corrosion and describes how it can be controlled by Dearborn Formula 700 or 702.

Dept. PO

Dearborn Chemical Company
Merchandise Mart Plaza, Chicago 54, Ill.

( ) Send a copy of Bulletin 5013
( ) Have a Dearborn Engineer call

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R-P&C valves

MARMADUKE

Continued from page 202

only as far as the counterbore. Even a good hefty smack with a sledge hammer wouldn't budge the piston.

"But that didn't stop Tuffy. He grabbed a couple of miners near the mine shaft and had them haul in a piece of timber used down below for shoring up.

"'Get on that battering ram,' he barked at his gang. 'I'll learn this stubborn engine who's boss around here.' And Tuffy was right. When that timber socked that piston, she moved. After backing off again about ten feet and rushing that battering ram at that piston, she moved another inch or so. Four socks and she was in far enough to get the cylinder head back on.

"Keeping quiet was all I could do, but this is the kind of thing you don't learn from books. When the engine was all buttoned up, Tuffy walked triumphantly over to the steam valve. This was his hour. He stood there for a minute like Genghis Khan about to address his troops. Then without warming her up, he suddenly spun her wide open. For a second nothing happened. Then to my utter surprise, that engine shuddered a little and started to roll.

"Don't ask me how that was possible because I've never been able to figure it out. She moaned and groaned—but roll she did, picking up speed with each revolution. Then after a few revs she got a solid shot of water from that untrapped main header.

"When the piston smacked that water against the cylinder head, she let out a noise you could hear over in British Columbia. The cylinder head shot off like a cannonball and a blast of steam filled that engine room. Tuffy and his strong-arm boys took off like greased lightning.

"I raced over and shut the main steam valve coming off the header before those boilers flashed all their water into the engine room. When the steam cleared away, I saw that parts of the cylinder, steam chest and cylinder head had blown through the wall 30 feet away. The 3-in. connecting rod was bent at right angles, and guides and crosshead were split. A few spokes were missing out of the big flywheel. And the governor was laying around in little pieces.

"Cylinder casting pieces I examined had ⅛-in.-deep grooves gouged from one end to the other. That was the worst wrecked engine I'd seen in years around power plants, afloat and ashore.

"Tuffy never did show up. Far as I know, he's still traveling. So I explained the cause to the superintendent before he got some dim-wit to take Tuffy's place. Then I outlined my plan for put-

And if you ask any of the power men who know about Mitchell piping, you'll get the same answer. For more than half a century our experts have been prefabricating and installing piping to meet the most severe service conditions, and our reputation is your guarantee of complete satisfaction. Let us see the plans for your next project . . . our estimate will not obligate you in any way.

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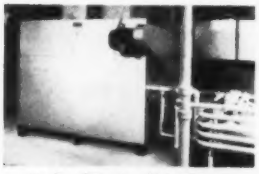
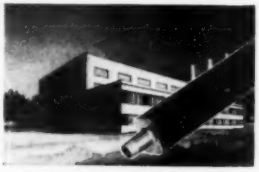
Don't be fooled...

Radiation can sometimes fool the "experts." Four tin cans — one painted white, one black, one highly polished and one covered with asbestos, after being filled with boiling water will cool at different rates. Which should cool most rapidly? Fill four cans as shown and record temperatures. Kirchoff's law still holds!

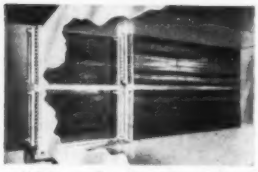
Radiation, conduction or convection — Bush finned surfaces offer high heat transfer coefficients meaning greater economy in coil size for a given load. Heating or cooling for product or comfort, there's a Bush unit to answer the need. Write for catalogs 350 and 425 which describe the Bush line and in addition contain valuable engineering data.



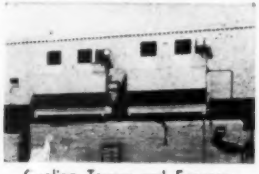
Air Conditioning Units 2 to 70 tons capacity for cooling, heating. 1800 to 18,000 CFM.



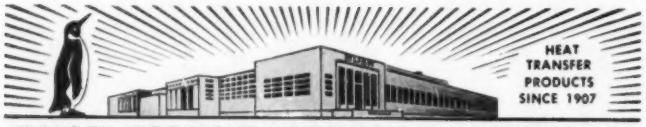
Standard Pipe Radiation. For heating. Copper tube, aluminum fin or all steel.



Water coils of copper tube aluminum fin for cooling, heating. Wide variety of sizes.



Cooling Towers and Evaporative Condensers 3 to 75 tons. Cuts water consumption 90%.



BUSH MANUFACTURING COMPANY

WEST HARTFORD 10, CONNECTICUT

MARMADUKE

Continued from page 204

ting that plant on its feet. He said he didn't know anything about power plants, but it all made sense to him. The job was mine.

"I first installed a steam separator to the engine and steam traps where needed. Then I put in a water-treatment system to keep those boilers from foaming. Next, I lined up the firemen and threatened to turn the first guy inside out who carried that water level more than 3 in. above the bottom gage-glass nut. When the new engine arrived two months later I installed her on the old base and lined her up.

"I stuck around long enough to have engineers visit the place from all over the province. She got to be known as the sweetest-running mine plant in that part of Canada," wound up Marmaduke, getting to his feet.

"If you guys will excuse me," he roared, looking at his empty bottle and heading for the door with a slight list to starboard, "I've got some ballasting to do at the Bent Propeller Bar."

Alex Higgins and I walked down the creaky old stairs after him.

"You know," said Alex, "Marmaduke may be a cantankerous old scoundrel and a barfly to boot, but I'd like to give younger, so-called operators today the same advice Abe Lincoln gave his swivel-chair generals."

"What was that?" I asked.

"When they complained about General Grant hitting the bottle, he advised them to try drinking the General's brand," answered Higgins.

BLADE CORROSION

Continued from page 97

field with minimum trouble.

Summary. In older machines a combination of corrosive and erosive deterioration results in a loss of material. In the more modern units deterioration is confined to erosion alone. Although erosion accelerates corrosion during operation, corrosion alone can be quite serious in units shut down for long periods. Advantages of modern chrome-alloy materials to resist corrosion are quite apparent during shutdown periods.

Under certain conditions, however, even the chrome alloys are severely attacked by impurities in steam such as acids, sugar, etc. There have been cases where this material has been replaced by a substitute that was specifically resistant to a particular type of attack. In general, heavy corrosion presents a more dangerous condition than erosion, mainly because of the very nature and location of the attack.

S-E-Co. Coal Valves Don't Stick

S-E-Co. Coal Valves don't stick because they are made with double racks and pinions. This design moves the gates squarely without binding. Furthermore, **S-E-Co.** Coal Valves are equipped with a U-shaped gate that places the supporting rollers and racks in side compartments away from contact with coal. As a result the operating parts are not subject to clogging or corrosion.

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The Perfect Package
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CYCLONIC
Combustion!

The Cyclotherm Cyclonic Combustion Principle is an entirely new and amazingly different method of heat transfer in the boiler industry.

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Boilers are designed for oil or gas operation from 18 through 500 HP, 15 to 200 lbs. operating pressure. Send for your copy of "Years Ahead in Steam Generation" today and find out for yourself the facts concerning Cyclotherm Steam Generators.

CYCLOTHERM steam generators
CYCLOTHERM DIVISION UNITED STATES RADIATOR CORP.

CYCLOTHERM — DEPT. 24 — OSWEGO, N. Y.

VENT FEED HEATERS

Continued from page 93

plete shutoff of air ejection if a valve is accidentally closed.

A further operating precaution is periodic inspection and cleaning of vent piping. Moisture-laden gas leaving a feedwater heater can be highly corrosive, and rust and scale can form within the lines.

For a day-to-day check on operating effectiveness follow station log closely. You can be almost sure any sudden drop in load of a feedwater heater has its cause in the venting system, particularly if temperature of condensate drains shows a corresponding drop.

LAZY EVAPORATOR

Continued from page 100

opened the free blow to atmosphere to check the amount of condensate. When this was wide open the vapor output suddenly rose to well above rating with the greater steam flow. When it was closed the output soon died down to the old lazy level.

We installed more gage glasses on the steam-coil water header and on drain legs to be sure coils were being properly drained. They were. Water remained at float-box level except when free blow or control valve bypass was opened. Whenever someone got a new idea about what might be wrong, we would take out the tube bundle to check—but found no answer. On the last go-around someone noticed quite a lot of water standing in some of the legs of the U-tube coils. It was suggested that perhaps some of these were not draining properly so that only part of the coil surface was active.

It seemed that when the free blow was opened pressure drop across the tubes was great enough to clear out the water temporarily. Close examination of the tubes showed they were not expanding properly as the steam heated them. There was little evidence of tube movement in the holes through the fixed tube support plates. Apparently, the light scale and small clearance in tube-sheet holes prevented tube movement through them. The tubes were bowing up, down or sideways to accommodate their increased length with heating. This collected condensate in the low spots preventing steam from blowing through the entire tube.

Several attempts to condition makeup to eliminate the hard scale didn't have much success. We couldn't keep the evaporator out of service more than a day or two at a time for rebuilding. So the manufacturer built a new coil assembly assuring proper tube drainage.

It's better
to be right
the first time
If you install a valve that's not precisely suited to the service, it will not last.
But you can be right the first time with Powell Valves because they're designed to meet specific flow control conditions.
There are more specifically adapted Powell Valves in use today than any other make.
The Wm. Powell Co.
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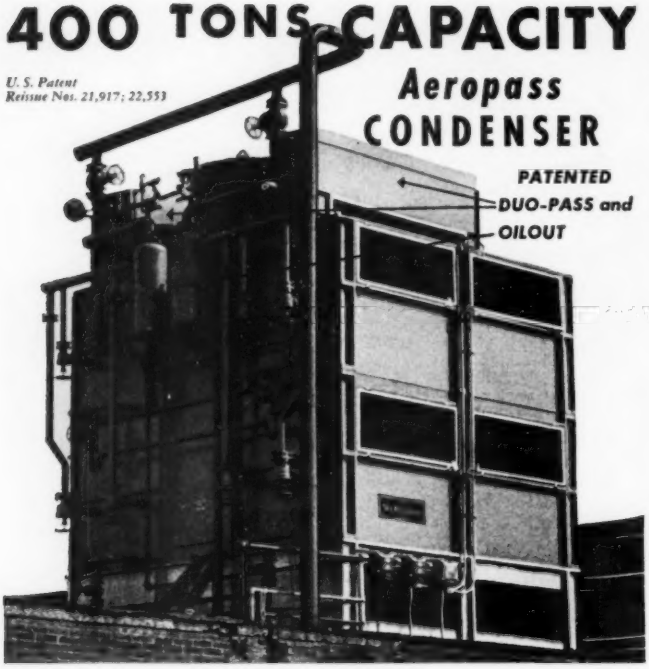
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

400 TONS CAPACITY

U. S. Patent Reissue Nos. 21,917; 22,553

Aeropass CONDENSER

PATENTED DUO-PASS and OILOUT



YOU USE LESS POWER... SAVE CONDENSER WATER... SAVE UPKEEP COST

For large refrigeration systems, NIAGARA gives you a choice between a battery of condensers (that may be cut on or off with the load) or a high capacity condenser that saves space.

Both have the patented "Duo-Pass" and "Oilout" that remove superheat and keep the system free of oil. Results: you save one-third or more of power cost and upkeep expense. Niagara Patented Balanced Wet Bulb Control gives lowest head pressure operation automatically. ***Write for Bulletin 111.***

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Over 35 Years' Service in Industrial Air Engineering

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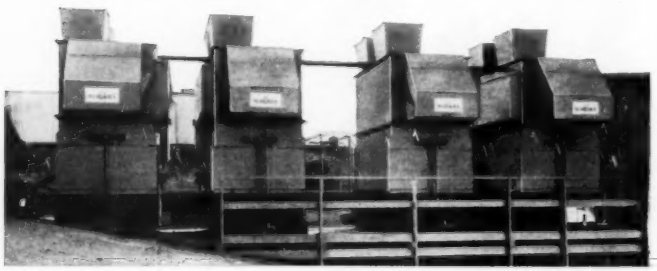
Field Engineers in Principal Cities of U. S. and Canada



Tube support plates were built with horizontal tube slots and the tubes preformed to move sideways as they expanded.

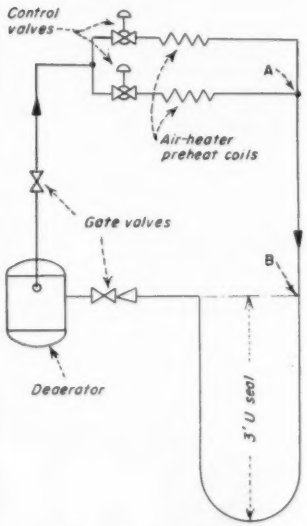
When this bundle was installed our evaporator troubles were over. The "lazy" evaporator became full of energy and produced up to 25,000 lb per hr of vapor without a struggle. Just an example to show the benefits of proper posture and complete elimination!

WITH OUR READERS

Continued from page 5

Headache?" series by Don Swift (Jan, p 85). His problem is water hammer and he only partially solves it since it's still present according to the last paragraph.

The following ideas are put forward without knowledge of heat-balance values and may prove uneconomical. Using the deaerator as both source and termination for this system would help, I believe. With both ends at the same pressure there is no need for traps and the heating cycle is considerably simplified. To permit better separation of steam and water at the outlet of the coils at low or changing boiler loads, it would be helpful to install a larger line than needed between A and B on sketch.



Proposed hookup for air-heater coils

The 3-ft seal may be suitable but depends on deaerator operating conditions. Installation of gate valves at each end of the system permits isolation of the coils and control valves for maintenance. Control valves are retained to simplify air-temperature regulation.

New York, N. Y. A J Breugelmans

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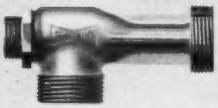
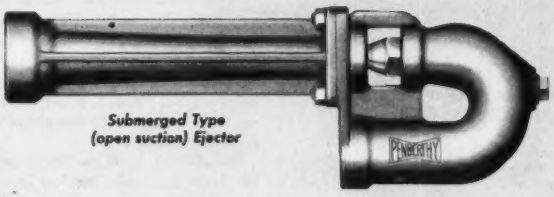
Standard Ejector for Steam or Air Operation



Standard Hydraulic Ejector

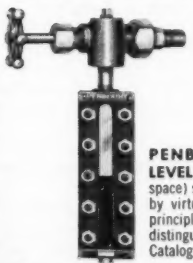
Stainless Steel Jet Pump for Handling Corrosive Chemicals



Submerged Type (open suction) Ejector

WRITE FOR *New* BULLETIN No. 512

OTHER PENBERTHY PRODUCTS



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PENBERTHY REFLEX LIQUID LEVEL GAGE—Empty space (or steam space) shows white and liquid shows black by virtue of a simple, unvariable optical principle. Accurate reading as far as you can distinguish black and white. Write for Catalog 35.

PENBERTHY AUTOMATIC INJECTOR—Will supply feed water to boiler at minimum cost. Quickly, easily installed, reliable under most severe operating conditions. Ask for Bulletin 513.

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DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

Detroit 2, Michigan

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Established 1886

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Canadian Plant—Windsor, Ontario

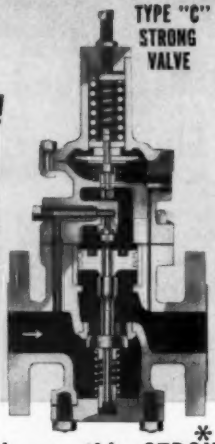
GET THIS VALVE!

Accurate pressure regulation!

FOR HEATING OR PROCESS JOBS:

- ...with intermittent or fluctuating demand;
- ...requiring accurate control;
- ...where dependability is essential.

TYPE "C" STRONG VALVE



For positive control, use this STRONG* single-seated, pilot-controlled valve!

Simple design, extra-heavy construction make STRONG's Type "C" regulating valve give trouble-free regulation. Semi-steel for pressures to 250 psi, 450° F.; cast steel to 600 psi, 750° F. With Anum-Metl† seat and disc, this valve automatically adjusts itself to control the flow of steam, air or gas required to maintain reduced pressure.

Write us about your pressure reducing problem or request our complete steam specialties Catalog 68-P.

TYPE "O"

Direct operated. Semi-steel construction suitable for initial pressures to 225 psi, 400° F. For steam, air, water or gas.

Features internal strainer, Anum-Metl† seat and disc. Direct operated, of extra heavy semi-steel, this valve is suitable for pressures to 225 psi, 400° F.

TYPE "K"

*Trade Mark Reg. U. S. Pat. Off.

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STRONG

More PLANT PROBLEMS

Begins on page 132

Answers to LOG question (continued)

dated card for each hopper. *TK* can use the same system if his plant has enough instruments.

LESLIE A PARKER
International Falls, Minn.

LOGS NO. 4, 5 and 8 should help *TK* if he studies them carefully.

FRED TRONSEN *Milwaukee, Wis.*

OUR PLANT is 2000 ft above sea level and winter temperatures go down to –43 F. So with a straight condensing plant that generates only power, our log, No. 10, p 134, had to be tailor made. Look it over for ideas.

A R EASTCOTT *Princeton, B.C.*

OUR PLANT has good results with a log having entry headings in a vertical column, time on a horizontal line. Portions of this log are on No. 13, p 136.

R D MINEHART *Mundelein, Ill.*

AT MIDNIGHT our operator takes meter readings in a small notebook. Later he transfers these to our weekly meter sheet. This sheet is kept in the engineering department where it can be gone over every day to discover poor running conditions. First reading is entered on bottom line, others on lines above.

From the weekly log, daily management reports, No. 6, 7, p 133, are worked up. This is the chief's completed report to management.

In addition to these forms we have two large log books, one for steam and the other for power, that run for six months. Meter readings are entered in these for each shift. Complete record of units is kept in them. Any mistakes are easily traced.

This system works well because operators soon spot waste of steam or water, and any other abnormal conditions.

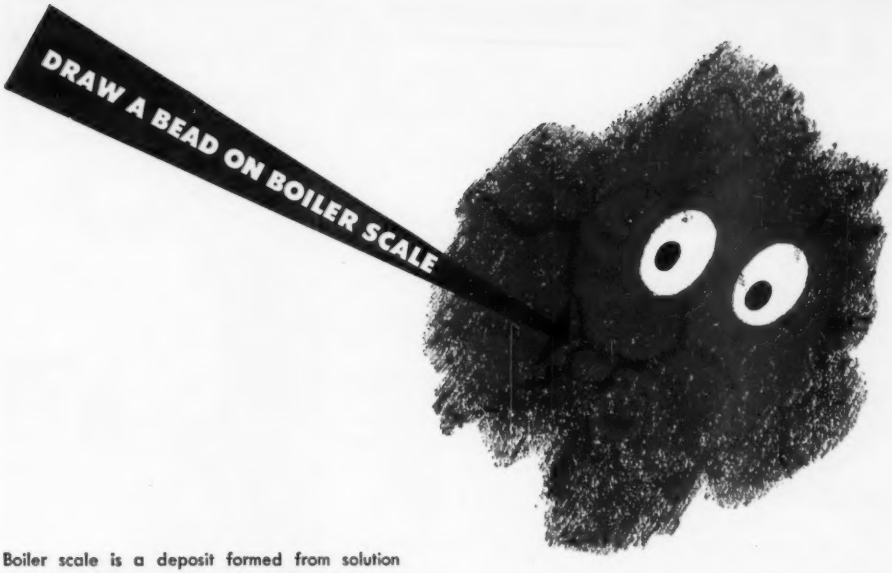
THOMAS JAMES *Verdun, Can.*

Answers to DIESEL question (cont.)

dle 15-kw load. Then there will be enough capacity to carry compressor starting load. Two identical units or one 20-kw and one 10-kw unit can be used. Two identical units would cut number of repair parts needed and make maintenance easier.

L W FITZPATRICK
Jefferson City, Mo.

BURN OIL to save about $22 per month in fuel bill. Diesel will save about $80 per month. Total savings possible are



Boiler scale is a deposit formed from solution directly in place upon a confining surface. It is crystalline and dense and usually retains its physical shape when removed. (Ref. ASTM D 887, D 933).

Use DREW POWER CHEMICALS

No boiler is exempt from scale under present day operating conditions. Scale results in tube failure, plant shut-down, trouble and inconvenience. It's the duty of every good water treatment company to recognize and solve this problem.

Draw a bead on boiler scale! Call in the Drew Engineer. The water samples and operating data that he obtains in your plant will be thoroughly analyzed in the Drew Laboratories, and you'll be given specific recommendations for corrective or preventive treatment. And you'll receive frequent and continous service, too.

Thorough investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Consult the nearest Drew engineer or write for information.

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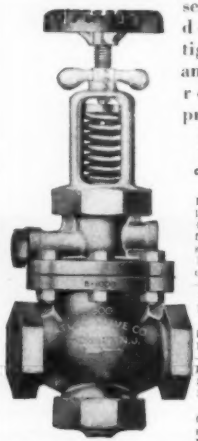
ATLAS TYPE "B," always a remarkable performer, is now a *much better* performer because it is STELLITED. The Pilot Valve is made entirely of that famous metal. The seat is STELLITE faced.

Try a Type "B" and you will find that it is unequaled for a service that demands tight seating and uniform reduced pressure.



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Here we show Fig. 112 of Bulletin No. 1-A (Ask for a copy) for 200 lb. steam service. All Bronze—Screwed or Flanged Ends—Pilot Operated. Sizes: ½"-¾"-1"-1¼"-1½"-2".

For 250 lb. service we offer Fig. 114 Iron Body—Flanged Ends—Pilot operated. Sizes: 2½"-3"-4"-5"-6"-8".

And for 400 and 600 lb. service see page 19 of Bulletin 1-A.

These valves are for temperatures to 900° F. Steel Body—Nitralloy Piston and Stainless Steel Piston Chamber—Flanged Ends—Pilot Operated. Sizes: ½", ¾", 1", 1¼", 1½", 2", 2½", 3", 4".

Type "B" is simple to maintain. Main valve disc and pilot valve are easily removed for cleaning or regrinding. The entire pilot valve can be lifted out by merely removing diaphragm and unscrewing pilot valve seat.

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More PLANT PROBLEMS

Begins on page 132

about $100 per month. This is based on several liberal assumptions.

Using these assumptions I find *GG* can invest up to $4900 on the diesel generator and oil burner. After looking over my calculations I believe *GG* is justified in converting his boiler to oil, but his electrical load is too small to justify the diesel, even though it saves some money.

P WILLIAMS *Somerville, Mass.*

OIL FIRING saves coal- and ash-handling labor and is cleaner. Saving in fuel bill won't be much.

Diesel won't pay off unless *GG*'s present power supply has frequent interruptions that spoil products. My figures show his electric power would cost $216 a month when generated by a diesel. This is more than his present cost.

FRANK A BUTLER *Dallas, Texas*

DON'T MIX STEAM AND DIESEL in a plant of this size. Convert boiler to burn coal or oil automatically. See p 108, Jan POWER for one way of saving money in the boiler room. Small steam engine or turbine can drive generator and the exhaust piped to process.

If *GG* expects load to increase, he can buy a 50- or 100-kw generator now and run it at part load until plant size increases.

B D RILEY *Brunswick, Ga.*

WILL PLANT GROW? This is the first question *GG* must answer. Present fuel and power bills are so small careful study is needed before installing a unit to generate power.

Don't forget that besides writing off diesel cost, *GG* will also have to pay for cooling water for the engine. Also, cost of generating current at different loads must be looked into. There may be times when the engine will run at 10% or less of its rating, jacking up kwhr cost.

Consider a small turbine for generating power if pressure is high enough.

Whether *GG* generates his own power or not, I think he should convert the hrt boiler to oil firing. Use gravity feed for oil by installing a tank overhead in the boiler room.

GEORGE MCNALLY *Kearney, NJ.*

POWER COMPANY service will be more satisfactory and just about as cheap when you consider maintenance, attendance and increased investment. Remember, a diesel needs expert care while motors and pumps may run longer without a major overhaul.

No matter what type or size engine

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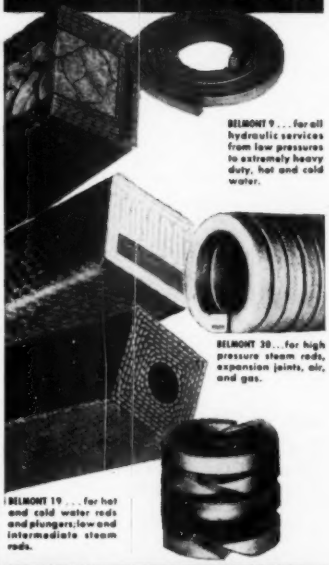
for WATER...STEAM...OIL...


BELMONT 9... for all hydraulic services from low pressures to extremely heavy duty, hot and cold water.
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Let us prove this prophet false

"We shall force the United States to spend itself into destruction."

These are the words of Lenin, father of Russian Communism. Quoted from page 191, volume xxi, of his Collected Works, they were printed recently in a metropolitan newspaper.

This is the announced goal of the Politburo, and it is the direction in which many patriotic citizens fear we are headed. For example, Congress has just appropriated $87 billion to be spent during 1952, and enacted taxes estimated to produce only $71 billion. The deficit is to be added to our national debt, already $259 billion; and this deficit will depreciate the national currency by another $16 billion.

Part of this stupendous appropriation is to rearm ourselves and the free world against Communist attack. But what about the rest of our spending?... Let us also be realistic. It is time for us as a nation to pause, reflect and consider well. We can do three things to avoid national bankruptcy:

1. Eliminate every non-essential federal expense.
2. Provide taxes to pay all obligations as we go.
3. Pay off some of our national debt every year.

Let every citizen who believes in preserving our nation from the economic termites within, as well as from the announced enemy without, become an active worker to prove the Russian prophet false.

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More PLANT PROBLEMS

Begins on page 132

GG installs he'll need standby service from the utility. Charge for this may be high. Without standby power there's danger of losing many creamery products during an engine failure in summer.

Diesel oil can be burned under the boiler but its cost may be higher than coal. Both diesel and fuel oil are cleaner than coal, an important consideration in a creamery.

E A ROBERTS *Carlsbad, N.M.*

TWO DIESELS will be needed if *GG* doesn't have utility standby power. He'd better look into cost of utility standby if he uses only one diesel. This is sometimes pegged just high enough to discourage private generation.

Don't burn diesel fuel under boiler. No. 6 is cheaper. Run a pipe between engine and burner so diesel oil can be used for boiler firing in an emergency.

Go over the entire control system to see if it will run OK within voltage regulation and frequency limits of the diesel generator.

If *GG* goes to a diesel he shouldn't overlook heat he can recover from jacket water. There are several ways to recover this heat that would probably be satisfactory to his board of health.

A M PALMER *Brooklyn, N.Y.*

DIESEL-DRIVEN COMPRESSOR for refrigerating system could cut plant running costs up to 60%. I think *GG* would be better off with this arrangement than with a small diesel generator.

CARL BACHMANN *Rego Park, N.Y.*

LARGER COMPRESSORS, run at off-peak hours, save creamery running costs. Cut coal and firing bills by using a suitable stoker. Also, a complete condensate-return system will help. Many creameries just "grow," they are not engineered jobs.

S E COMBS *Pittsboro, N.C.*

SINGLE-STAGE TURBINE is more economical than a diesel. Exhaust can be used for process and condensate returned to boiler.

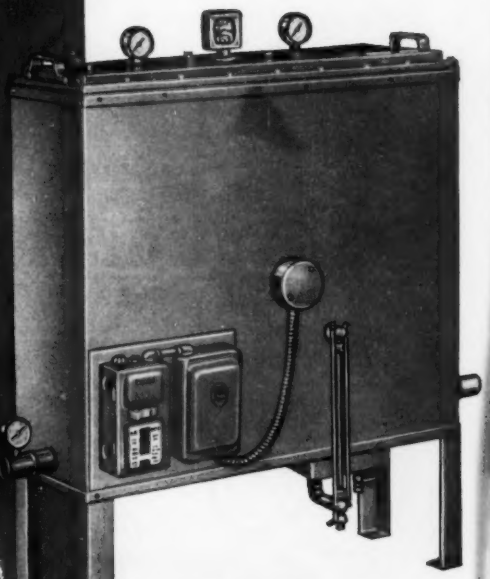
Turbine uses less floor space, needs smaller foundation. Fireman can run turbine with less attention and maintenance than diesel needs. Small diesel may have less overload capacity than a turbine of the same rating.

If only one generating unit is put in, *GG* should consider buying storage batteries or a gas-engine-driven generator for standby service. See boiler manufacturer before converting to oil firing.

A J BREUGELMANS *New York, N.Y.*

NOW...new Houdaille *water-oil separator for* turbine oils

DRI-PURE



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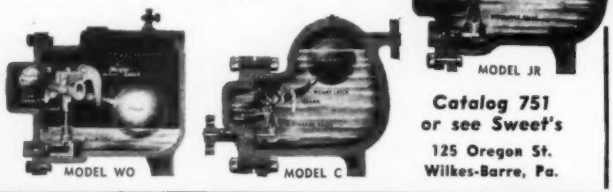

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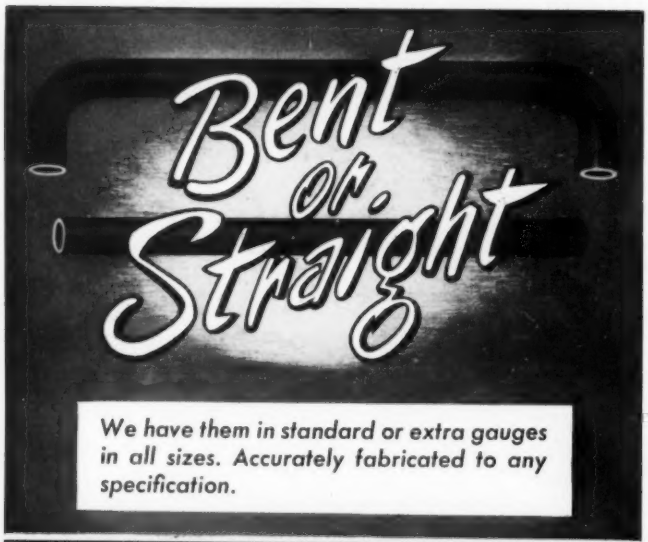

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My Biggest Boner

► When we were kids we swam in a brook that had a small waterfall. It was always fun to stand under the falls, and I never let a summer day pass without getting under at least once. Until recently I thought waterfalls were only something to be remembered. That is, until a waterfall started in our power plant.

My fireman and I overhauled a box-header boiler, using Key plugs in handholes. When the job was finished I filled the boiler with cold water to see if I could spot any leaks. Sure enough we found a few Key plates that had to be tightened. One, up in the corner, leaked so badly that the more I worked on it the more it squirted in my face.

I yelled to the fireman to let some water out of the boiler. He opened the drain and about a minute later I thought I was once again a youngster standing under a waterfall. The fireman didn't open boiler vent so a vacuum was created in the boiler as water drained. Key plugs were pulled into header, allowing cold water to drench me.

I only got wet, but I shudder when I think what might have happened if I had put hot feedwater instead of cold water into the boiler. I now have a standing rule to open boiler vent before touching a valve to either fill or drain a boiler. The boys make sure they do. Accidents like this have had more serious results in other plants.

Art Cannon

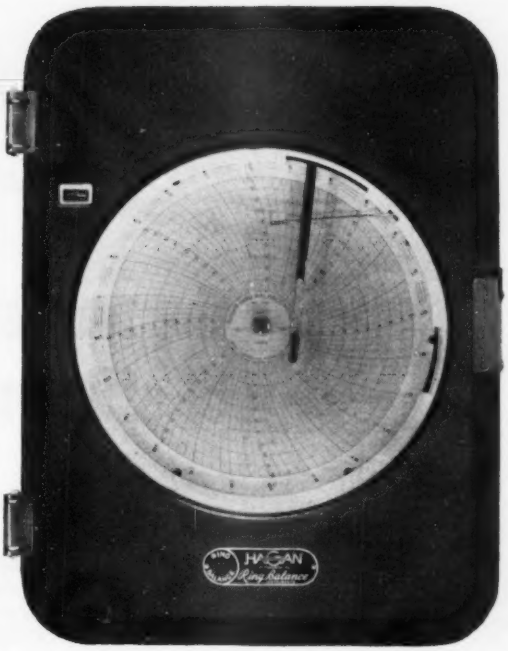
Laurence Harbor, N.J.

use dependable HAGAN

Ring Balance Flow Meters

to measure flow of

water–gas–steam–oil–air–other fluids



There are many reasons why you get dependable records when you use Hagan Ring Balance Flow Meters.

These include the unique ring torque resistance system which not only makes it possible to meter low flows reliably, but also provides an integral and convenient means for altering the meter capacity to any value over a 3½ to 1 range. Range changing is further simplified by a dead weight method of calibration. Other features include:

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- Adjustable full scale range
- High sensitivity at low flow rates
- Mercury level not critical

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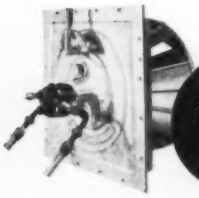

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More FREE BULLETINS

Begins on page 165

B14 **INSTRUMENT TRANSFORMERS**—Indoor and outdoor, potential and current types, plus metering outfits. 94-page catalog GEA-4626E gives ratings, ASA accuracy classifications, prices. General Electric Co, Schenectady 5, N. Y.

★ **ELECTRICAL DATA BOOK**—For architects and engineers, 230-page revised edition, book B-2161-E gives details on power plant, electrical distribution, utilization and accessory equipment. Dimensions, specifications, applications. ★Request direct, not from POWER, from your nearest Westinghouse Electric Corp district office.

B15 **WIRES AND CABLES**—For the coal mining industry. 52-page catalog gives performance and specification data on insulation and jacket compounds, portable cords and cables with ratings up to 5000-v. R H Turner, U S Rubber Co, Rockefeller Center, New York 20, N. Y.

B16 **LIGHTING MAINTENANCE**—12-page bulletin outlines 8-step program for planned fluorescent lighting maintenance, gives trouble-shooting information. Sylvania Electric Products Inc, Lighting Div, 60 Boston St, Salem, Mass.

B17 **MOTOR USE**—*Application of Direct-Connected Synchronous Motors to Reciprocating Compressors* — AIEE reprint, 12-page publication No. 1200-TEC-1111. Photos, Charts. Electric Machinery Mfg Co, Minneapolis 13, Minn.

B18 **GENERATORS**—Two reprint articles, *Supercharged Cooling of Generators*, and *Five Stages to Stability* describe hydrogen cooling and voltage regulation. Bulletins 05R7773, 4 pages, and 05R7776, 8 pages. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

B19 **INDUSTRIAL LAMINATES**—*Textolite* laminated plastics. 8-page bulletin CDL-38 gives mechanical, chemical, physical, thermal and electrical properties, and tolerances. General Electric Co, Chemical Div, Pittsfield, Mass.

HEAT EXCHANGERS

B20 **HEAT EXCHANGERS** — 8-page bulletin illustrates basic components—heads, shells, and tube bundles, gives service recommendations. Superior Combustion Industries, Inc, Times Tower, Times Square, New York 18, N. Y.

MAINTENANCE AND SAFETY EQUIPMENT

B21 **METALLIC PACKINGS**—Flexible "V" metal insert, metallic valve stem, all metallic, high temperature aluminum, braided copper, etc., packings. 8-page bulletin has photos, specifications, service recommendations. Raybestos-Manhattan, Inc, Packing Div, Manheim, Pa.

B22 **POWER PLANT PACKINGS**—6-page folder keyed to plant requirements. Photos, construction information, sizes, etc., for shaft, plunger, valve stem, piston and sheet packings, gaskets. Johns-Manville Corp, 22 E 40th St, New York 16, N. Y.

B23 **PISTON RINGS** — Plain compression, bronze band, oil, sealing, etc., rings. 20-page catalog has photos, uses, operating data, gives ordering instructions. Safety Seal Piston Ring Co, PO Box 106, Fort Worth, Tex.

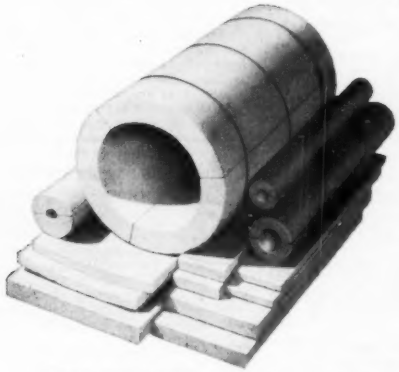
B24 **CONNECTOR SIZE CHART**—Shows correct fitting to use for armored, leaded, flexible steel, nonmetallic sheathed, and service entrance cables. Thomas & Betts Co, Inc, 46 A Butler St, Elizabeth, N. J.

B25 **WIRE ROPE ASSEMBLIES**—Detail specifications on wire rope with fittings permanently attached. For operating controls, as parts of machinery and equipment, for slings and hoists. 24-page catalog 5201. Macwhyte Co, Kenosha, Wis.

(*Continued on page 222*)

Does Your Present Heat Insulation Have All These Advantages?

Kaylo Heat Insulation is a hydrous calcium silicate—a revolutionary heat-saving material—outstanding both in performance and ease of application.



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Contact your Murray representative or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY, BURLINGTON, IOWA

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Builders of Steam Power Equipment for over 75 years

More FREE BULLETINS

Begins on page 165

MATERIALS HANDLING

B26 **MATERIALS HANDLING ANALYSIS**—16-page pocket-size guide book presents 28 questions to determine basic material-handling requirements for factories, warehouses. Automatic Transportation Co, 149 W 87th St, Chicago 20, Ill.

B27 **FORK TRUCK ATTACHMENTS**—4-page folder illustrates 25 special truck attachments. Revolving forks, electro magnet, upender, scoop, fork extensions, etc. Elwell-Parker Electric Co, 4205 St Clair Ave, Cleveland 3, Ohio.

B28 **CONVEYOR AND ELEVATOR BELTING**—32-page catalog NY-1697-C gives specifications, construction, uses, capacity, installation information. Charts, photos, formulas. F E Tilley, New York Belting and Packing Co, 1230 Avenue of the Americas, New York 20.

B29 **OSCILLATING CONVEYORS**—For feeding, cooling, screening bulk materials. 24-page booklet 2444 illustrates torsion-mount units for heavy duty, flex-mount units for lighter duty. Dimensions, weights, capacity, hp charts, photos. Trough widths 8 to 48 in. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

METERS AND INSTRUMENTS

B30 **THERMOHMS**—34-page catalog EN-84 lists entire line of general and specialized resistance thermometers, with parts and accessories. Photos, specifications, wiring diagrams, uses. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

B31 **RADIAMATIC PYROMETERS**—General purpose, low range, small target, and miniature types, also accessories. 28-page catalog 9300 describes complete line. Operation, theory, construction, typical applications. Minneapolis - Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Ave, Philadelphia 44, Pa.

B32 **ADJUSTABLE PORT VALVES**—For gas, air, oil, steam and water regulation. 12-page catalog 1800 gives mounting dimensions, specifications, maximum pressures, ordering information, principle of operation. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Ave, Philadelphia 44, Pa.

B33 **FLOW METERS**—*Flowrator*, by-pass, sight flow, etc., types. Available from stock. 8-page brochure 10529 gives specifications, capacities, sizes, dimensions. Fischer & Porter Co, 5580 County Line Rd, Hatboro, Pa.

B34 **STROBOSCOPES**—8-page bulletin describes instruments and auxiliary light sources. Specifications, uses, prices, photos. General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.

PIPING, VALVES, FITTINGS AND SPECIALTIES

B35 **EXPANSION JOINTS**—Free-flexing for low, controlled-flexing for medium, and *Flexoniflex* for high pressure applications. Also dual, hinged, balanced and bulkhead units. 20-page bulletin CMH-127 gives specifications, sizes, amount of expansion, uses. Photos, diagrams. Flexonics Corp, 1397 S 3rd Ave, Maywood, Ill.

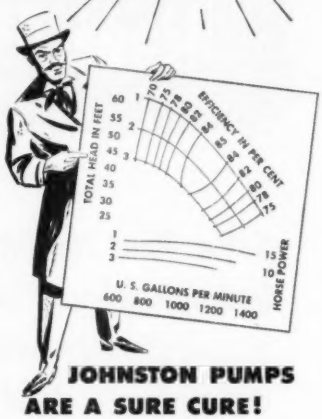
B36 **PIPING SPECIALTIES**—Temperature controllers, steam traps, pressure reducing valves, venting valves, flow valves, supply valves, float traps, etc. Catalog sheets give specifications, photos, line diagrams. Hoffman Specialty Co, 1001 York St, Indianapolis 7, Ind.

B37 **BOILER TUBES**—Bent and straight, copper and steel. 6-page bulletin gives list prices, working pressures, shipping weights. Boiler Tube Co of America, McKees Rocks, Pa.

B38 **TUBE FAILURES**—40-page booklet TR516 presents factors affect-

Suffering from

Horsepower Headaches?



JOHNSTON PUMPS ARE A SURE CURE!

Don't blow a fuse because you are overloaded with pumping troubles. The steep head-capacity and flat horsepower characteristics of Johnston Vertical Turbine Pumps prevent overloading of the motor regardless of fluctuations in capacity or head. Low starting torque requires less horsepower and results in higher efficiency and longer life of the motor.

The Treatment Is Painless

Every Johnston Pump is engineered for the specific duty for which it is intended. Trained hydraulic engineers are available at your nearest Johnston dealer or at the Johnston factory to furnish detailed information, proposals and anything else necessary to cure your particular pumping malady.

The Johnston Wonder Drug

Johnston Turbine Pumps are ideally suited for industrial and municipal applications because of their non-overloading characteristics, simplicity of construction, compactness, ease of installation, elimination of priming, low starting torque, capacity adjustment features and minimum maintenance costs.

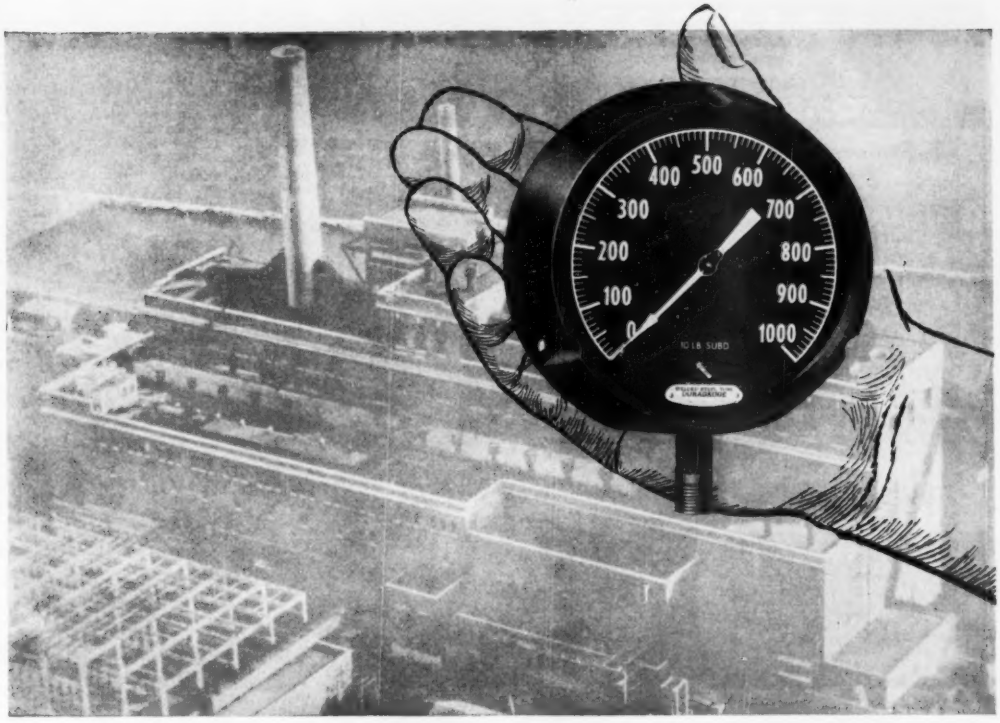
Free diagnosis!

No matter what your pumping job, contact your nearby Johnston Dealer or write the factory direct for a free diagnosis of your pumping headaches.

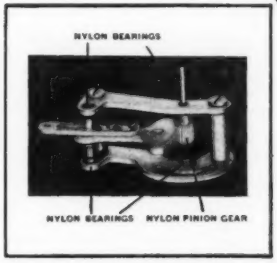
JOHNSTON PUMP COMPANY

3272 EAST FOOTHILL BLVD., PASADENA 8, CALIF.

Headquarters for Vertical Turbine, Mixflow and Propeller Pumps Since 1909



Outlasts ALL OTHERS!



Since the introduction of the Nylon Movement* in 1947, the Ashcroft Duragauge has set new standards for pressure gauge performance in the most "killing" services.

Here's why: All worthless weight and mass of parts is engineered *out* of the Duragauge Nylon Movement. The light, strong, dimensionally stable nylon pinion gear and bearings have low coefficients of friction. They absorb vibration and pulsation—resist wear—far better. All this adds up to sustained accuracy, improved sensitivity, lower maintenance and longer service life.

Whether you generate electricity, refine petroleum, process chemicals or anything else demanding accurate pressure indication or recording to insure safety, product quality, or cost control – install Ashcroft Duragauges. Your nearby Ashcroft Distributor will gladly help you select the right Ashcroft Duragauge for your specific needs.

*Patented

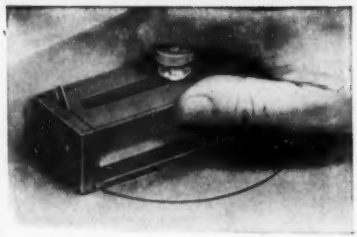
ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

ALLPAX
GASKET CUTTERS

The Engineer's Magic Wand when a Gasket is needed in a hurry



These simple, practical tools shape gaskets from any gasket material quickly, easily and accurately . . . save many hours in time by meeting emergency needs effectively and economically . . . pay for themselves first time they're used.

Made in two types: New Improved ALLPAX cuts holes from ¼" to 48" in such materials as felt, rubber, cork, asbestos sheet, etc.

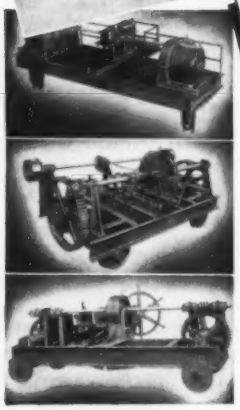
ALLPAX Junior Cutter cuts gaskets ¼" to 6" round, oval, square or irregular shapes.

ALSO: *Packing for all services; Valve Discs; Retainer Packing; Molded or Mandrel Cut Packing Rings; Packing Hooks.*

Send for *Illustrated Catalog covering the complete ALLPAX line. Consult your nearest distributor for your requirements.*

THE ALLPAX COMPANY INC.
805 Mamaroneck Ave., Mamaroneck, N.Y.

Superheat Sheet Packing . . . Oil Proof Sheet Packing
Red Rubber Sheet Packing . . . Diaphragm Sheet Packing . . . Cloth Inserted Sheet Packing



FROM the smallest hand operated, to the large motor operated, MURRAY Gate Hoists are designed and built in a wide range of capacities, from less than 1 ton to over 100 tons. During our over half century of designing and building gate hoists, we have developed many designs for the different types of gate hoist problems. Perhaps we have several designs and patterns that will fit your requirements. In planning gates or gate hoists, we suggest you communicate with us before your plans for the project as a whole, are complete . . . it will save expense and much preparation time. We also build gate hoists especially from your plans and specifications, if desired.

Our Engineering Department is at your service any time, to help you solve problems involving Power Dam Gates and Gate Hoists.

D. J. MURRAY MANUFACTURING CO.
Manufacturers Since 1883
WAUSAU, WISCONSIN

More FREE BULLETINS

Begins on page 165

ing tube life in high-pressure, high-temperature use. Shows results of failure investigations on boiler, heat exchanger, etc., tubes in power, oil and chemical processing fields. Tubular Products Div, Babcock & Wilcox Co, Beaver Falls, Pa.

B39 TUBE FITTINGS—Also tube-to-pipe adapters, fabricating equipment. Brass, aluminum, steel and stainless construction. 76-page catalog has photos, drawings, dimensions on complete line. Parker Appliance Co, 17325 Euclid Ave, Cleveland 12, Ohio.

B41 STEAM TRAPS — Open bucket, float and thermostatic types. Also strainers, vents, air eliminators. 20-page catalog 600 gives capacities, construction, dimensions, photos. Wright-Austin Co, 3245 Wight St, Detroit 7, Mich.

B42 SEPARATORS — For steam, oil, air and gas. 28-page catalog 500 gives descriptions, photos, dimensions, pressure drop, steam flow and velocity charts. Wright-Austin Co, 3245 Wight St, Detroit 7, Mich.

B43 BRONZE VALVES—With renewable composition discs. 4-page folder gives specifications, standard sizes, illustrates basic valve types. Fairbanks Co, 393 Lafayette St, New York 3, N. Y.

PUMPS

B44 ROTARY PUMPS—New *Imo* unit for general service. Capacities to 80 gpm, 275 psi. 4-page bulletin L313B gives description, viscosity tables, dimensions, shows cut-away section. De Laval Steam Turbine Co, Trenton 2, N. J.

B45 SCREW PUMPS—18-page bulletin S204 shows sectonal views, installations, dimensions, selection. *Warren-Quimby type.* Warren Steam Pump Co, Inc, Warren, Mass.

WATER TREATMENT

B46 BOILER FEEDWATER TREATMENT — For a high-pressure, high-makeup power and steam producing plant. 12-page reprint from Midwest Power Conference. Shows flow diagrams, heating and water systems, demineralizing system at Philadelphia Electric Co Schuylkill Station. Graver Water Conditioning Co, 216 W 14th St, New York 11, N. Y.

B47 BOILER FEEDWATER TREATMENT — 4-page folder P-30 describes *IonXchange* equipment, softeners, hydrogen-zeolite, deionizers. Illinois Water Treatment Co, Rockford, Ill.

B48 COOLING-WATER TREATMENT —For engine cooling systems. 4-page folder 5015 discusses chromate control in closed systems, application of treatment, dosages, test methods. Dearborn Chemical Co, Merchandise Mart Plaza, Chicago 54, Ill.

B49 WATER CONDITIONING — 20-page bulletin 611 covers various methods and their purposes. Features improved equipment for zeolite softening, also automatic, ion exchange, deionizing, filtering, etc. equipment. Elgin Softener Corp, Elgin, Ill.

B50 AIR AND GAS DIFFUSER—For sewage and industrial waste treatment, water conditioning, biological manufacturing and absorption processes. 4-page folder 6530 describes *Colafex* unit with fabric element. Infilco, Inc, Tucson, Ariz.

WELDING

B51 STUD WELDING MAINTENANCE —12-page bulletin 1003CC has wiring diagrams, trouble-shooting, maintenance and service instructions for stud-welding gun. Drawings, charts, photos. Stud Welding Div, KSM Products, Inc, Merchantville, N. J.

B52 CAST-IRON ELECTRODE—Nickel-free electrode *EutecTrode* 27, offers high-tensile weld with uniform carbon in the deposit. Specifica-

They're DROP FORGED

of STEEL...

W-S Screw-End and Socket-Weld Fittings

There are several big benefits to you implied in this simple statement of fact about W-S Fittings.

First, forging means *strength*—the strongest, most compact physical form, steel for steel, obtainable by commercial methods of fabrication.

Second, *being* stronger, forged fittings are much *smaller* and *lighter*, size for size, than other types.

Third, *dimensional accuracy* is characteristic of the forging process—and because forged bodies *are* more accurate, they chuck better, can be machined to *closer*, more *uniform tolerances* than other types.

To these inherent advantages of *forged* fittings, add Watson-Stillman's modern manufacturing facilities, a production control system that's air-tight from furnace to finished product, and a sales engineering staff dedicated to SERVICE in the largest sense of the word. The total is heavily weighted in favor of the advantages of W-S Double-Diamond Forged Steel Fittings.

• Lower Service Cost • More Uniform
• Stronger • Smaller • Lighter • Tighter

SOLD THROUGH LEADING DISTRIBUTORS . . . EVERYWHERE

WATSON-STILLMAN
ESTABLISHED 1848

W-S 9-M-1

DISTRIBUTOR PRODUCTS DIVISION

ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

These EVERLASTING advantages give better service from

Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Angle Blowing Valve.

BOILER BLOW-OFF VALVES

When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The sealing valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The blowing valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

Write for descriptive bulletin

EVERLASTING VALVE CO.
49 Fisk Street, Jersey City 5, N. J.

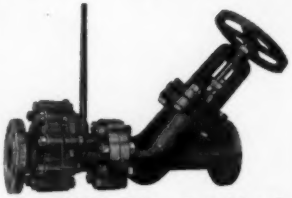


Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

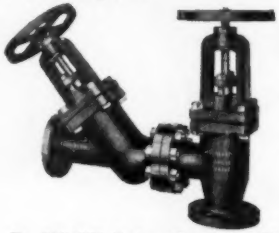


Fig. 6571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

Everlasting Valves

TRADE MARK "EVERLASTING" REG. U.S. PAT. OFF. EV-340

FOR EVERLASTING PROTECTION

More FREE BULLETINS

Begins on page 165

tions and data sheets available. Eutectic Welding Alloys Corp, Dept P, 172nd St and Northern Blvd, Flushing, N. Y.

B53 **WELDING REPRINTS** — *Aircomatic Welding of Austenitic Stainless Steels*, form ADR 77, 16-pages; *Aircomatic Welding Refinery Components and Pressure Vessels*, Form ADR 76, 8 pages; *Inert-Gas-Shielded Metal-Arc Welding of Magnesium*, Form ADR 75, 8 pages. Reprinted from the *Welding Journal*. Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.

B54 **WELDING FITTINGS** — Alloy steel, in all shapes, sizes and schedules. 4-page bulletin outlines *Key-Kast* advantages. Key Co, E St Louis, Ill.

B55 **WALL CHART** — Lists *Ampco* bronze weldrod and wire products by trade name and AWS-ASTM designation. Also gives applications, properties, recommended current and polarity, diameters, etc. Ampco Metal, Inc, 1745 S 38th St, Milwaukee 46, Wis.

OTHER EQUIPMENT

B56 **METRIC EQUIVALENTS**—17 x 22 in. wall chart "C" also converts inches to feet and gives decimal equivalents. Frederick Post Co, 3650 N Avondale Ave, Chicago 18, Ill.

B57 **METAL THRESHOLDS**—28-page pocket-size book shows abrasive cast, extruded and rolled steel thresholds, with cross-section drawings, specifications, and typical installations. Wooster Products, Inc, Dept P, Wooster, Ohio.

B58 **HYDRAULIC SETTING REFRACTORIES**—For casting special refractory shapes and for gunning and slap-troweling applications. 12-page brochure gives uses, handling methods, service recommendations, properties, photos. Johns-Manville Corp, 22 E 40th St, New York 16, N. Y.

B59 **BOILER SETTINGS**—With plastic and castable refractories. 24-page catalog gives uses, methods of construction, design and manufacture, includes cross-section drawings and charts. Ramtite Co, Div of S Obermayer Co, 2563 W 18th St, Chicago 8, Ill.

B60 **CASTABLE REFRACTORIES** — For boilers, burners, furnaces, etc. 12-page bulletin 41 gives uses, features, physical characteristics. Laclede-Christy Co, 5900 Manchester Ave, St Louis 10, Mo.

B61 **NOISE ELIMINATION**—Pamphlet illustrates principles of noise measurement and how noises are related to the human ear. Suggests methods of control. Industrial Acoustics Co, 333 Jackson Ave, New York 54, N. Y.

B62 **CARBON AND GRAPHITE PRODUCTS**—Porous and impervious grades, for chemical and process, metallurgical, mechanical and electrical fields. 20-page catalog section S-5005 gives sizes, physical characteristics, corrosion resistance, heat conductivity, etc. National Carbon Co, Div of Union Carbide and Carbon Corp, 30 E 42nd St, New York 17, N. Y.

INDEX AVAILABLE

Copies of the Index for POWER articles from January to December 1951 are available.

Single copies are available for $.50. Address Miss J. McGee, POWER, 330 W 42nd St, New York 36, N. Y.

...150,000 HORSEPOWER to produce *Kaiser Aluminum*

THE *80 Nordberg Gas Burning Radial Engines* in the new Chalmette, Louisiana, reduction plant each develop 1820 horsepower at 400 rpm, and drive 1290 kilowatt direct current generators to provide the vast amount of electricity needed to produce aluminum. *First metal was poured less than ten months after construction of this plant was started.*

This efficient method of generating direct current eliminates the need for rectifier stations, with the consequent losses that would occur in transforming alternating current to direct current.

Nordberg Radial Engines are designed to give simple, compact, economical power. Their ability to burn gas efficiently permits this large internal combustion engine plant, the largest in Louisiana, to produce power 24 hours a day—day in, day out . . . at very low generating cost, which compares most favorably with hydro-electric or steam power.

NORDBERG MFG. CO., *Milwaukee, Wisconsin*

Builders of America's Largest Line of Heavy Duty Diesel Engines, from 10 to 10,000 H.P.

P152

BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

MERCOID

FOR INDUSTRIAL APPLICATIONS REQUIRING POSITIVE CONTROL OF PRESSURE, TEMPERATURE, LIQUID LEVEL ETC.

They Have What Experienced Engineers Want—
POSITIVE SAFETY
EASE OF INSTALLATION
CONVENIENT ADJUSTMENTS
YEARS OF DEPENDABLE PERFORMANCE

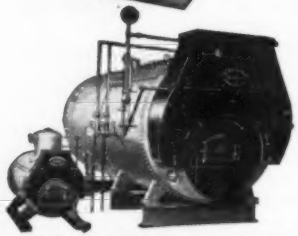
CONTROLS PERFORM IMPORTANT RESPONSIBILITIES, AND SHOULD BE SELECTED WITH DISCRIMINATION

MERCOID
Is your guarantee of Complete Satisfaction

WRITE FOR CATALOG 700 -- PLEASE MENTION THIS PUBLICATION

THE MERCOID CORPORATION
4201 BELMONT AVE. CHICAGO 41, ILL.

A DOZEN
STEAM BOILER POINTERS
FROM
LEFFEL...



Check off the boiler advantages that add up to economy in your plant operation!

√ Dependable	√ Designed for overload
√ Self-contained	√ Rugged construction
√ Compact	√ Safe
√ Easily Cleaned	√ Lowest operating cost
√ Coal, oil or gas fired	√ Easily maintained
√ 6 to 250 HP (actual)	√ Maximum combustion

Leffel's generations of boiler-making experience assure you that your next boiler will be your best — if it's a Leffel.

Write for descriptive catalog

The James Leffel & Co.
Established 1862

DEPT. O SPRINGFIELD, OHIO

APPOINTMENTS

Westinghouse Electric Corp appoints C H Bartlett mgr of the transformer div, and Wm E Francis becomes mgr of information services of the lamp div. H K Schnetter is new administrative assistant to the eastern dist mgr of the lamp div, C N Neumann is sales promotion representative, both with headquarters in New York.

Name of the Central Station Dept is changed to Electric Utility Dept, effective Feb 1.

Reliance Electric & Engineering Co moves its Detroit office to 12326 Hamilton Ave, and moves its Cleveland office to 13967 Cedar Road.

Riley Stoker Corp promotes C Freeman Hawley to chief mechanical engineer; L Dudley Bruce becomes chief project engineer; and Alden G Carlson becomes chief structural engineer.

Cleaver-Brooks Co appoints three manufacturers representatives—E C Giberson, 3719 Center St, Des Moines, Iowa; V N Harwood Co, 250 Delaware Ave, Buffalo 2, N. Y.; Wilson-Weesner-Wilkinson Co, 310 S 2nd St, Nashville 6, Tenn.

Combustion Engineering - Superheater Inc elects Wm J Vogel and Robert M Hatfield vice-presidents.

Allis-Chalmers Mfg Co announces retirement of Forrest Nagler, mgr and chief engineer of the atomic power section. He is inventor of the Nagler type of axial-flow high-speed hydraulic turbine runner. While he was with Canadian Allis-Chalmers he directed construction and field testing of 8 of the turbines for the 1,000,000-hp Shipshaw hydroelectric plant.

H Stanley Bimpson becomes chief engineer of the steam turbine section, and Charles D Wilson becomes engineer-in-charge of steam turbine design.

C M Garland, Ingleside, Ill., resumes his consulting engineering practice in power and steam generation, for the period of the emergency. He had retired in 1949 after 32 years as an active consultant in the field.

General Electric Co decentralizes its transformer and allied products div. The new departments and their mgrs are power transformer, Wm S Ginn gen mgr; distribution transformer, Raymond W Smith gen mgr; capacitor, Alfred W Hough gen mgr; laboratory-engineering, Dr Karl B McEachron mgr. Samuel H Thomas becomes mgr of power transformer sales, Edward V Dillon mgr of feeder voltage regulator sales, Clement E Sutton Jr is mgr of distribution transformer sales, Harold M Towne mgr of lightning arrestor and cutout sales, Harold M Jalonack mgr of marketing research and product planning. Frederick G Stebbins is mgr of power factor capacitor sales, and Donald J Harrington mgr of specialty capacitor sales.

Carl A Salmonsen becomes gen mgr of the industry control dept; John C Helies is gen mgr of new appliance control dept. John T Harrington becomes regional mgr for communication equipment, with headquarters in Boston.

C H Wheeler Mfg Co appoints Zay B Curtis Jr asst to the president; John M

Discarding condensate because of OIL?

If you are throwing away valuable condensate rather than risk its return to the boiler because of oil contamination, filtration with Sorbo-Cel may be the answer to your problem.

Low in Cost

This specially processed diatomaceous silica powder provides a simple, economical method of removing emulsified oil from water and thereby obtaining an oil-free condensate for boiler feed or other use. Total cost ranges from only 1¢ to 3¢ per 1000 gallons of water filtered.

How it works

A small amount of Sorbo-Cel is simply mixed with the oil-contaminated water, which is then pumped through a pressure filter. Here the oil globules are removed by the specially treated Sorbo-Cel particles, and both are retained upon the filter screen. The filtered water alone passes through.

Does complete job

Sorbo-Cel does a complete job of oil removal. In addition, it removes other suspended matter such as rust, scale, clay and precipitates. And its action is so efficient that large volumes of water can be filtered in a relatively short time.

A bulletin that gives further facts about this low-cost way to remove oil from water is available on request. Just use the coupon below.

JM

Johns-Manville
SORBO-CEL

Johns-Manville
Box 290, New York 16, N. Y.
Send me free bulletin giving advantages of Sorbo-Cel filtration.

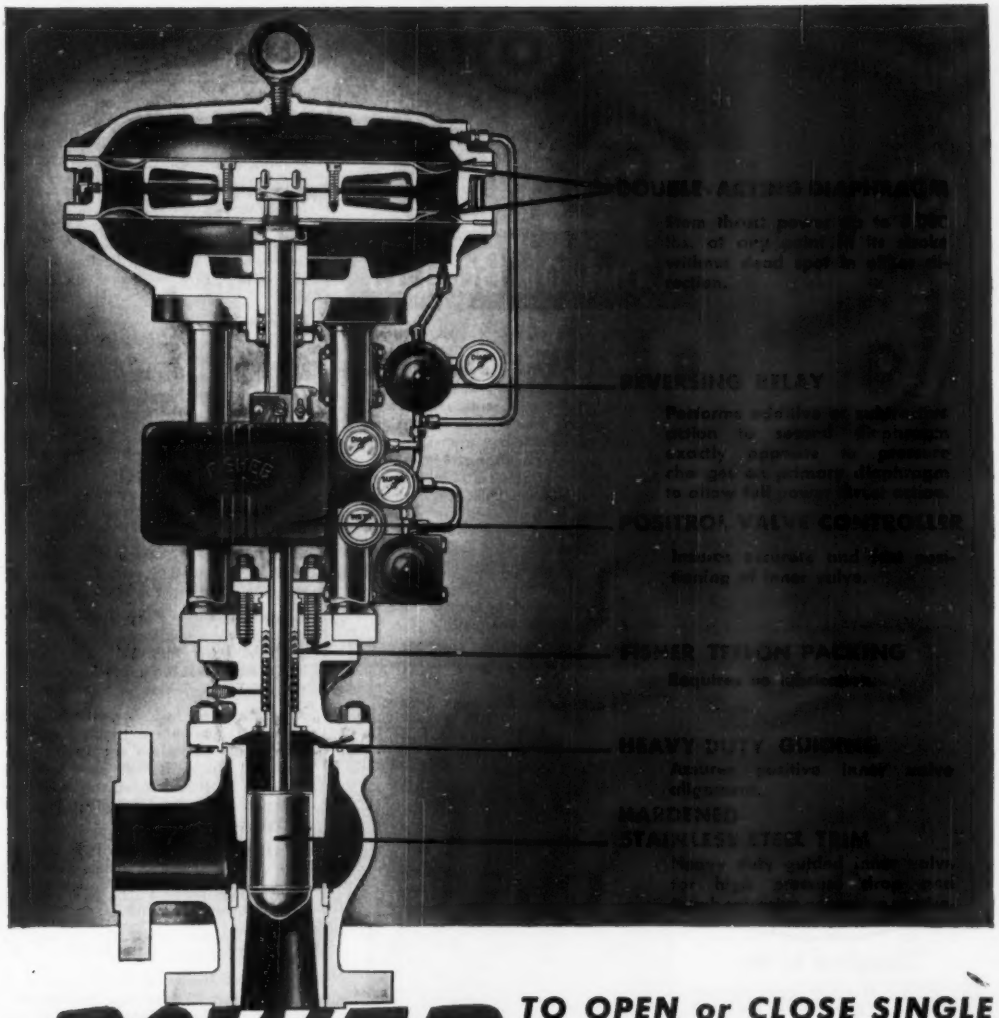
Name_____

Company_____

Address_____

City_____ State_____

POW-4



POWER

TO OPEN or CLOSE SINGLE SEATED VALVES UNDER HIGH PRESSURE DROP CONDITIONS

Fisher Type 5700-458 "AMT" pressure balanced diaphragm motor valve will actuate large single-seated valves for tight shut-off on high pressure drops. It features full pneumatic performance — no springs, no levers or weights. Double diaphragm avoids backlash effects probable with single diaphragm construction. Develops up to 5,000 lbs. stem thrust with 30 lbs. air supply. Designed for fast stroke action. Fully strokes inner valves in 13 seconds.

WRITE TODAY FOR BULLETIN E-5700

FISHER **AMT***

DIAPHRAGM MOTOR VALVES FOR HEAVY DUTY SERVICE

*AMT "Answer Me Twice". In action, pressure added to one diaphragm, subtracted from other.

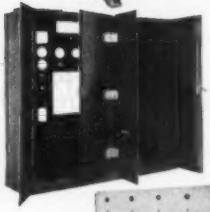
FISHER GOVERNOR COMPANY Marshalltown, Iowa

Cubicles

Cabinets

and

Control Boards



There's no substitute for experience, and Littleford can offer 70 years of experience in the fabrication of metals to unerring accuracy. These long years of handling metals, producing products with skilled workmen, reflect in the fabrication of panelboards, switchboards, cubicles, cabinets, instrument panels, control centers and switchgear housings. Littleford facilities are modern and afford an unprecedented standard of dependability. Littleford is qualified to fabricate all type of metal including mild steel, stainless, monel, nickel, aluminum and other alloys. If you have a problem involving fabricated enclosures, remember there is no substitute for experience, and no substitute for Littleford workmanship.

Send your blueprints to Littleford and be assured of quality at lower cost.

LITTLEFORD

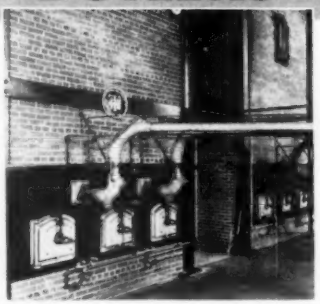
LITTLEFORD BROS., INC. ★ 438 E. Pearl St., Cincinnati 2, Ohio

TITUSVILLE
IRON WORKS CO
TITUSVILLE, PA.

3-Drum
WATER TUBE
BOILERS

"Standard of the Industry" FOR EFFICIENT STEAM GENERATION

Schools and institutions demanding low cost boiler operation with maximum steam output are an important part of the long list of Titusville 3-Drum Water Tube Boiler users in many different fields. May we consult on your coming needs?



State Teachers College, Edinboro, Pa.
Two Titusville TDL Boilers, 160 lb., pneumatic spreader stokers. Contractor: Dravo Corporation, Pittsburgh, Pa.

THE TITUSVILLE IRON WORKS COMPANY
a division of Struthers Wells TITUSVILLE, PENNA.
Representatives in Principal Cities

More APPOINTMENTS

Begins on page 228

Sperry becomes sales mgr of the heating pump dept, Economy pump div.

A P Green Fire Brick Co appoints James W Minter dist sales mgr of its new Birmingham, Ala., office.

Monsanto Chemical Co appoints three supervisors in its engineering sales dept, organic chemicals div: Charles F Towse, field service; Marvin R Paullus, sulfuric acid section; Fred M Berkey, chlorine section.

Lukenheimer Co reorganizes its sales management organization. In the Eastern div, Melvin W Pauly is sales mgr, R J Sardieck dist mgr at Philadelphia; in the Central div, Harold H Layritz is sales mgr, E R Tieberman dist mgr at Dallas, Tex.; in the Western div, Charles W Burrage is sales mgr, C B Rosser Jr dist mgr at Los Angeles.

Borg-Warner Corp appoints Thur Schmidt director of research and development for the Ingersoll products div.

C O Bartlett & Snow Co opens a new office at 91 Central Square, Pittsburgh 28, Pa. John M Marston is in charge.

Cooper-Bessemer Corp opens combined regional office and warehouse at 1410 S Jefferson Davis Parkway, New Orleans. T E Kraner, branch mgr, is in charge, assisted by F A Gehres.

Aluminum Co of America appoints James P Growdon engineering consultant on hydraulic and related engineering problems. B J Fletcher becomes chief hydraulic engineer. L B Kuhns becomes chief construction engineer, succeeding John W Schreiber who is retiring.

Air Reduction Co names Dale D Spoor mgr of equipment and process sales dept.

Dravo Corp appoints John K Beidler gen mgr of the machinery div.

Davey Compressor Co has new regional mgr in Milwaukee—A H Knief.

Fairbanks Morse & Co promotes J A Cuneo to general sales mgr; Milo C Roy is mgr of the Chicago branch; J W Wright becomes mgr of the Omaha branch; C E Dietle mgr of the diesel sales div; W B Wylly mgr of the Atlanta branch; L A Weom branch mgr at St Paul; Clifford J Schroeer mgr at St Louis. Gordon R Anderson becomes general mgr and W H Kingsley sales mgr of the electrical div; George C Worthley is new general mgr and Joe Peterson sales mgr of the scale div.

Tube Turns, Inc appoints Lincoln D Hall dist mgr in charge of the Mid-continent territory, with headquarters in the Wright Bldg, Tulsa, Okla.

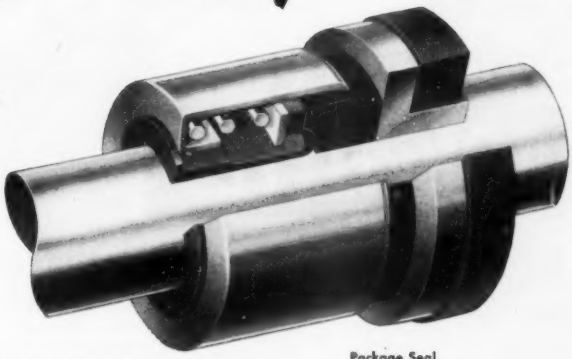
Preferred Utilities Mfg Corp names Technical-Industrial Sales Co, Citizens Bldg, Cleveland, Ohio its sales representatives in Northeastern Ohio.

Toledo Pipe Tools new sales representative in the Texas area is Harry C Cochran.

Stevens Institute of Technology an-

Garlock Mechanical Seals Save 3 Ways!

1. **REDUCE LEAKAGE OF COSTLY OR HAZARDOUS LIQUIDS ON ROTATING SHAFTS**
2. **NO WEAR ON SHAFT OR SHAFT SLEEVE**
3. **LONG LIFE WITH LESS PRODUCTION LOSS AND LOWER REPAIR COST**



Package Seal

It is most economical to use Garlock Mechanical Seals whenever *leakless* operation of rotary shafts on pumps or other equipment is required.

Once the proper Garlock Mechanical Seal has been installed on a rotary shaft you can forget about leakage. A leakless seal is provided by a positive contact between carefully lapped metal-to-carbon or metal-to-metal mating surfaces.

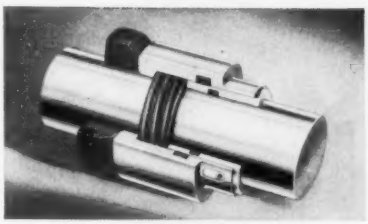
Garlock Mechanical Seals are recommended for use on rotating shafts against practically any liquid including strong acids. All metal parts are available in a variety of corrosion-resistant materials.

The CHEVRON* Seal, for pressures up to 200 p.s.i., and the "O"-Ring Seal, for pressures up to 1000 p.s.i. and over, are individually engineered for each application.

The Package Seal is a low-cost, production-run seal for pressures up to 150 p.s.i. Package Seals of standard construction (brass case and brass washer) are stocked at the factory, for shafts size $\frac{3}{8}$" to 2", advancing by sixteenths, and for shafts size 2" to 3", advancing by eighths.

For complete information write for our Mechanical Seal Booklet or ask your Garlock representative.

CHEVRON* Seal



"O"-Ring Seal

*REGISTERED TRADEMARK

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

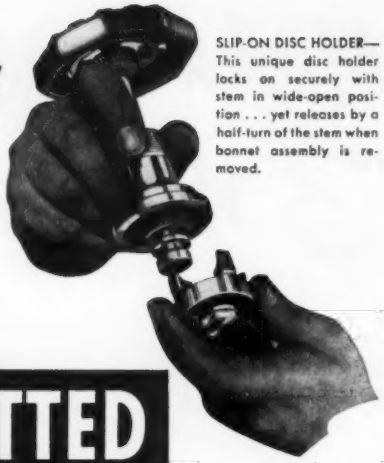
GARLOCK **PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS**

KENNEDY

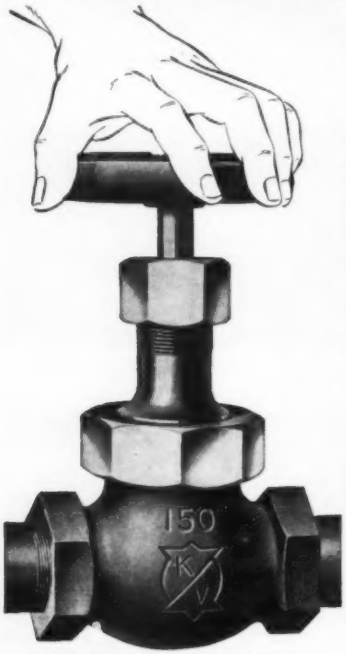
bronze globe valves...

JOB-FITTED

for longer service, easier maintenance



SLIP-ON DISC HOLDER—This unique disc holder locks on securely with stem in wide-open position . . . yet releases by a half-turn of the stem when bonnet assembly is removed.



KENNEDY Fig. 89, Bronze Globe Valve
150 lbs. steam, 300 lbs. WOG, non-shock

YOU KEEP MAINTENANCE COSTS DOWN with KENNEDY Bronze Valves because they are *job-fitted*—every valve specially designed and engineered for the job it has to do.

THE KENNEDY FIG. 89, for example, is designed for services where frequent inspection, cleaning of internal parts and quick renewal of the composition disc are required.

HEAVY UNION BONNET RING permits easy dismantling and reassembly of the valve without risk of damage to body-bonnet bearing surfaces.

RENEWABLE COMPOSITION DISCS are available in a variety of materials to meet a wide range of fluid, pressure and temperature requirements.

RUGGED BODY has an unusually high seat to prolong disc life by utilizing full thickness of disc before disc-holder strikes the base of the raised seat.

LONG-WEARING PACKING—molded rings of lubricated asbestos—maintains easy operation and tight seal to prevent leaks. Valve can be repacked under pressure.

FOR BEST RESULTS and real economy, standardize on KENNEDY Bronze Valves . . . and the complete line of KENNEDY Iron Valves, Malleable, Cast-Iron and Bronze Pipe Fittings.

Write for Circular 101—Buy from Your Local Distributor

THE KENNEDY
VALVE MFG. CO. • ELMIRA, N.Y.

Est. 1877

VALVES • PIPE FITTINGS • FIRE HYDRANTS

More APPOINTMENTS

Begins on page 228

nounces that Dr Frank Martinuzzi, internationally known authority on gas turbines, has been appointed to its faculty.

Refinite Corp promotes Norman E Tucker to vice-president in charge of sales.

Rockwell Mfg Co appoints W S Andrews New York dist sales mgr. The company announces acquisition of the Deluxe Saw & Tool Co and the Karbide King Tool Corp with plants in Chicago, Ill., and High Point, N. C. A G Feldman will continue to supervise the Chicago plant; Claud T Miller will manage the plant at High Point.

Cummins Engine Co, Inc names John T Weber mgr of sales development.

Dollinger Corp appoints two new district representatives—Sabel E Baum in Ala., western Fla., and part of Tenn.; Roy A Stipp in N. C., S. C., and eastern Tenn.

New York Belting and Packing Co appoints Carl G Link Jr northern dist sales mgr, with headquarters in Chicago. Wm I Butler is southeastern dist sales mgr, with headquarters in Memphis. New factory representatives are Frank E Cavanaugh, northeastern dist; Joseph Van Schaik, Rocky Mountain states; Wayne E Law, oil field factory representative, Rocky Mountain states.

Niagara Mohawk Power Corp appoints J Marion Geiger chief electrical engineer, succeeding Raymond T Henry, who has retired.

Minneapolis-Honeywell Regulator Co names Stephen A Keller general mgr of the valve div, and Howard MacDonald valve div plant superintnedent.

John M Drabelle, who is retiring from Iowa Electric Light and Power Co, plans to continue in consulting, advisory and counselling work as an engineer.

Hanna Engineering Works appoints Power Transmission Products div of Portland Iron Works, 1107 N W 14th Ave, Portland 9, Ore., distributor for pneumatic and hydraulic cylinders and valves. Guy B Arthur is sales mgr.

Hewitt-Robins Inc moves its headquarters offices to Stamford, Conn. Eastern div and export sales offices remain at 370 Lexington Ave, New York.

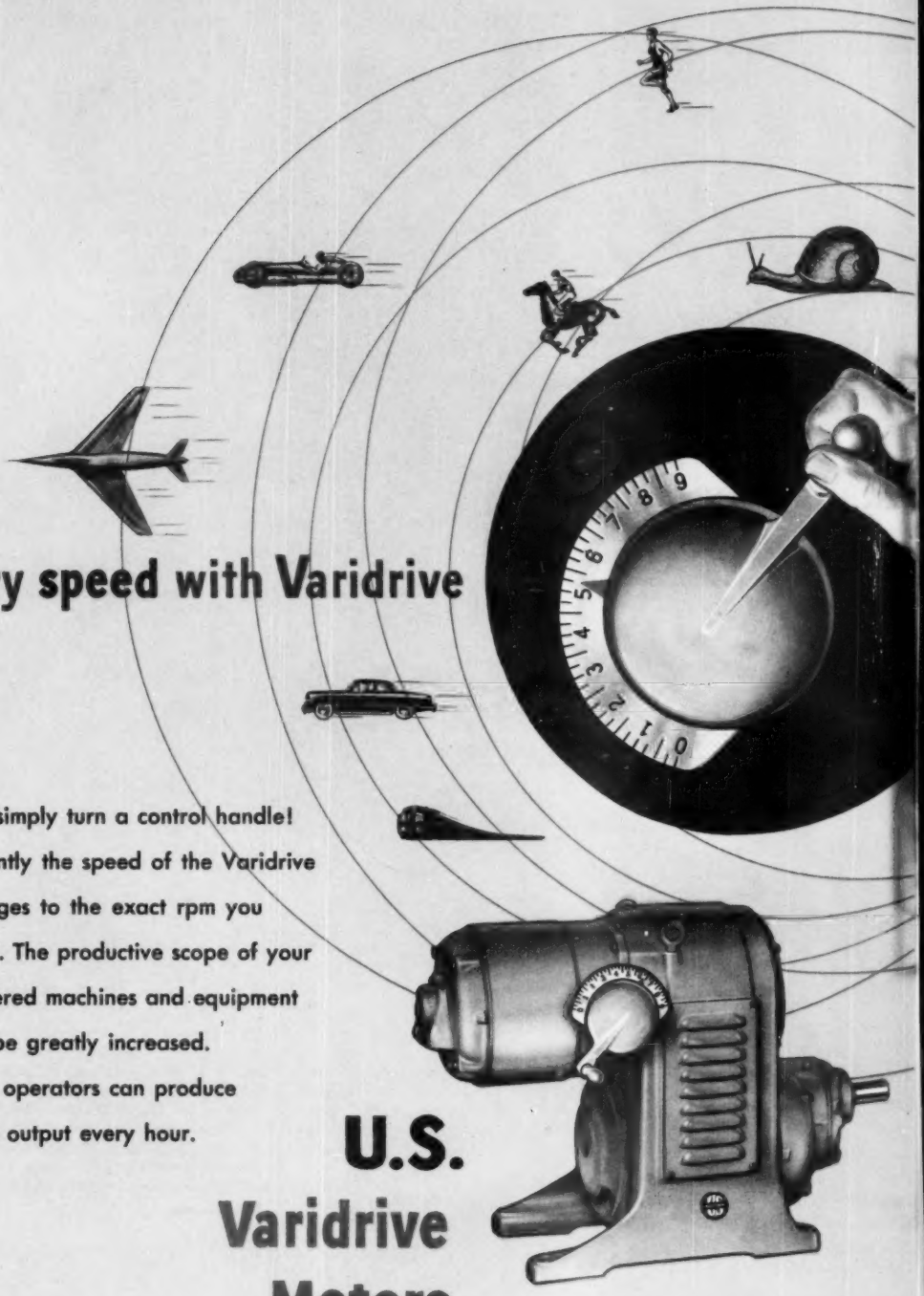
Hall Laboratories, Inc appoints Irving B Remsen Jr technical consultant on waste water problems.

Hagan Corp names Donald E Dixon service representative in the Denver district.

Dresser Industries, Inc elects Tom Slick to the board of directors. Slick is a well-known oil capitalist, philanthropist and founder of the Foundation of Applied Research, the Institute of Inventive Research and the Southwest Research Institute, all noted for their scientific research in specialized fields.

Campbell Chain Co appoints G J Kohler New York State sales representative.

J N Fauver Co Inc opens a branch of-

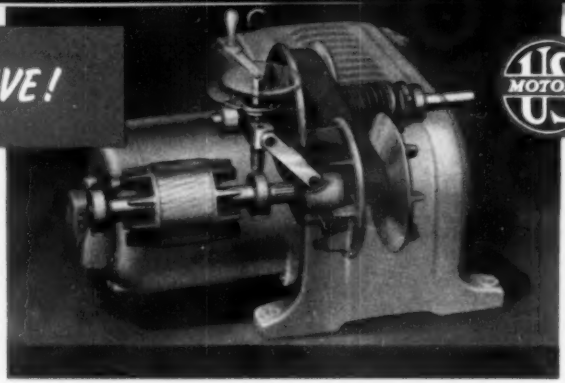


every speed with Varidrive

You simply turn a control handle! Instantly the speed of the Varidrive changes to the exact rpm you need. The productive scope of your powered machines and equipment will be greatly increased. Your operators can produce more output every hour.

U.S. Varidrive Motors

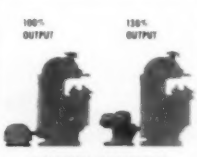
GO MODERN — GO VARIDRIVE!



Get any RPM

YOU GET THESE EXTRA ADVANTAGES IN THIS MIRACLE MOTOR

ANY SPEED
BY TURNING A DIAL



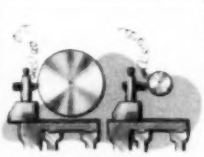
INCREASES PRODUCTION
UP TO 30%

NO BELTS TO SHIFT
NO GEARS TO CHANGE

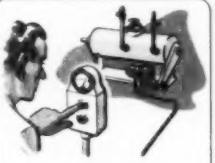
ELIMINATES EXTRA
CONTRAPTIONS

REDUCES FATIGUE
GIVES WORKER INCENTIVE

CHANGES SPEED TO
FIT WORKER'S RHYTHM

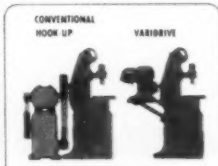


GIVES EXACT SPEED
FOR SIZE OF WORK

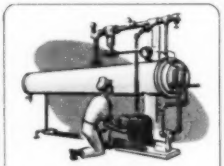


LOCALLY OR
REMOTELY CONTROLLED

IMPROVES QUALITY
OF MACHINE WORK



COMPACT—CAN INSTALL
DIRECT ON MACHINE



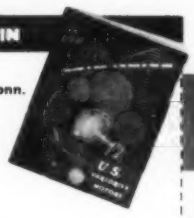
PERMITS FINEST
PROCESS ADJUSTMENTS

VARIOUS TYPES
2 TO 10,000 RPM

Machines with only 1, 2 or 3 speeds can't give maximum output. *Keep pace with progress.* Take full advantage of your machine's unused production. Give it infinite variations of speeds best suited to the job and to the operator's ability.

Many users of U. S. Varidrive Motors obtain 10 hours' production in 8 because the operator can select just the right speed for each operation. He gets it ***instantly*** by merely turning a control dial. He speeds up his work to synchronize with his rhythm of movement. He sets the speed faster for quick work, slower for very precise operations. *Install Varidrives and save.*

MAIL COUPON FOR VARIDRIVE BULLETIN



U. S. Electrical Motors, Inc. P
Los Angeles 54, Calif. (Box 2058) or Milford, Conn.

Send VA Varidrive Motor Bulletin

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

U. S. VARIDRIVE MOTOR

Long condenser tube life starts here!

CHASE ANTIMONIAL ADMIRALTY

(A patented alloy)

Thousands of installations since 1935 prove that Chase Antimonial Admiralty* adds years of service to condenser life.

Chase Antimonial Admiralty has *enough* antimony to resist dezincification. And antimony does not lessen resistance to other forms of corrosion . . . keeps tubes tough and rugged under heavy-duty assignments.

FREE BOOK — Send for the new Chase book discussing problems of corrosion in condenser and heat exchanger tubes, selection of proper alloy, and information on installing tubes. Fill in coupon below.

*U. S. Patent No. 2,061,921

SPECIAL STOCKS OF ANTIMONIAL ADMIRALTY TUBES are carried in our NEW YORK, BALTIMORE, NEW ORLEANS, LOS ANGELES Warehouses. *Also carried by* Vinson Supply Co., Tulsa, Standard Brass & Mfg. Co., Houston.

NEW BOOK includes Specifications, Weights, Dimensions and other data.

Chase Brass & Copper Co., Dept. PO 452
Waterbury 20, Conn.

Please send me your free book on Condenser and Heat Exchanger Tubes.

Name_____

Firm_____

Position_____

Address_____

City_____ State_____

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• *The Nation's Headquarters for Brass & Copper*

Albany†	Chicago	Denver†	Kansas City, Mo.	Newark	Pittsburgh	San Francisco
Atlanta	Cincinnati	Detroit	Los Angeles	New Orleans	Providence	Seattle
Baltimore	Cleveland	Houston†	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

BIDDLE

NUMBER 5 OF A SERIES

Instrument News

ARE YOU SURE OF PROTECTION THROUGH YOUR GROUND CONNECTIONS?

Biddle Ground Tester measures low resistance

Photo Courtesy Copperweld Co.

In spite of apparently good lightning rod or arrester protection, lightning frequently will cause severe damage if high ground resistance hampers its dissipation in the earth. Lightning storms are prevalent in the northeastern states during the spring and fall months. Plants in this section should make a thorough round of ground resistance tests. Aside from the hazards to personnel, thousands of dollars may be saved in damage to electrical equipment and in loss of power and stoppage of production.

The MEGGER® Ground Tester is the easiest, quickest and most accurate method of determining ground resistance. It is an instrument specially designed for the purpose and should be used wherever possible. Direct readings are automatically obtained in ohms. It provides its own source of current—no batteries, or other remote source required. It's easy to carry, too. Has approval of the Associated Factory Mutual Insurance Companies.

Don't put it off—write today for "Grounding Electrical Circuits Effectively" by J. R. Eaton (Bulletin 25T2-P) and our Biddle manual on "Ground Resistance Testing" (Bulletin 25J-P).

HERE'S A "GOOD COMPANIONS" KIT FOR PRACTICAL ELECTRICAL ENGINEERS AND MAINTENANCE MEN

Men concerned with all-around-the-plant electrical tests and resistance measurements tell us that these are "indispensable" tools:

Midget Megger Electrical Insulation Tester for detecting dirt, moisture and deterioration in advance of failure, or as a trouble-shooter after failures occur.

The Midget Megger Circuit Testing Ohmmeter for measuring conductor resistance of coils, contacts and relays, and checking continuity of circuit and grounded parts.

Be sure to write for your copy of our new Bulletin 21-85-P today.

JAMES G. BIDDLE CO.
1316 Arch St., Philadelphia 7, Pa.

Please mail me ☐ Bulletin 25T2-P
☐ Bulletin 25J-P ☐ Bulletin 21-85-P.
Thank you.

Name _____

Job _____

Company _____

Address _____

JAMES G. BIDDLE CO., 1316 ARCH ST.
PHILADELPHIA 7, PA.

ELECTRICAL TESTING • SPEED MEASURING INSTRUMENTS • LABORATORY & SCIENTIFIC EQUIPMENT

More APPOINTMENTS

Begins on page 228

fice at 1534 Keystone Ave, Dayton, Ohio. Ken Miller is in charge.

Wilkening Mfg Co appoints Helmuth G Braendel director of engineering and production. Harry O Moffett is his assistant. Wm J Miller is production mgr.

Watson-Stillman appoints Adolph deMatteo chief engineer; R W Schreck gen mgr of sales, hydraulic div; Jackson Kemper gen mgr of sales, distributor products div.

Rust Engineering Co appoints George L Jordy mgr of the chimney div, succeeding Eric Plagwit who becomes special representative and chimney consultant.

Dominion Bridge Co, Ltd appoints R S Eadie vice-president and mgr of the eastern div; A S Gentles becomes vice-president and mgr of the Pacific div; G P Wilbur is vice-president and mgr of the Ontario div. D B Armstrong becomes chief engineer, R M Robertson asst chief engineer, and P G A Brault designing engineer, all of the eastern div.

Sterling Electric Motors appoints these additional distributors: Industrial Electrical Co, 1244 McHenry Ave, Box 1025, Modesto, Calif.; Butte Machinery Co, 510 E Aluminum, Butte, Mont.; Pomona Electrical Machinery Co Ind, 260 N E End Ave, Pomona, Calif.; Industrial Motor Electric, 449 West St, Woodland, Calif.; Meyer Bros Co, Phillipsburg, Pa.; Transmission Equipment Co, 527 Lexington Ave, New York 17, N. Y.

Manufacturers Light and Heat Co appoints A B Lauderbaugh chief engineer.

OBITUARIES

Morris W Kellogg, 79, founder and chairman of the board of the M W Kellogg Co, died at his New York City home on Feb 22. He had started the company in 1901 as a small pipe fabricating shop in Jersey City. They pioneered in fabricating penstocks for the hydroelectric power industry, then turned to manufacturing tanks for storing materials under high pressure and temperature. Kellogg developed hammer-welded stills, eventually became prominent in design and construction of petroleum refineries and chemical plants, and today the company is one of the world's leading organizations of the kind.

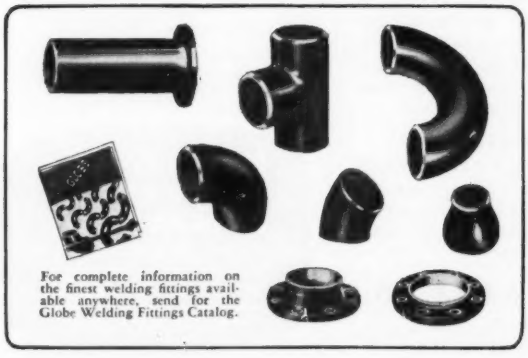
Morris E Leeds, 82, founder and chairman of the board of Leeds and Northrup Co, died Feb 8 at Lake Wales, Fla. He had received many honors, including the Edward Longstreth Medal of the Franklin Institute for invention of the first balance-method industrial recording instrument, later known as the Leeds Recorder, and the Philadelphia Chamber of Commerce first annual award for leadership in industrial relations.

Charles S Ackley, 78, secretary of McKiernan-Terry Corp, died Dec 16. He had several inventions to his credit, including an electrical bottom-hole heater for oil wells, and held patents on processes for soil solidification.

...from billet to tube to fitting

From this modern control room, every step in the heating, piercing, rolling and reduction of seamless tubes is closely monitored. This is typical of the highly specialized equipment demanded by the Globe precision process . . . insuring high quality and close tolerances.

GLOBE highly specialized process controls are used to produce the finest in WELDING FITTINGS



For complete information on the finest welding fittings available anywhere, send for the Globe Welding Fittings Catalog.

Globe precision-process manufacture *begins with the billet* — continues through the making of the seamless steel tube — (Globe alone among welding fitting manufacturers produces seamless steel tubes) — and extends through to the production of the finished fittings.

Because Globe has highly specialized controls — at every stage of manufacture *in its own plant* — you can be sure of uniform high quality seamless welding fittings when you specify Globe.

GLOBE STEEL TUBES CO.
MILWAUKEE 46, WISCONSIN

Chicago, Cleveland, Detroit, New York, Philadelphia, St. Louis, Denver, Houston, San Francisco, Glendale, Cal.

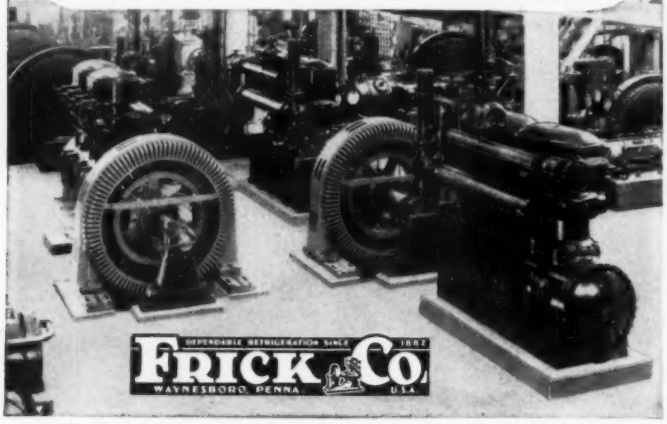
Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy — carbon — seamless steel tubes — Globeiron (high purity ingot iron) seamless tubes — Globe Welding Fittings.

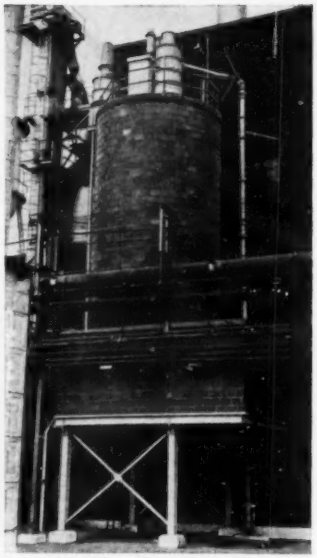
Celanese Corp. Uses 6420 Horsepower of Frick Refrigeration

Fourteen Frick refrigerating machines are in operation at the Amcelle plant of Celanese Corporation of America, near Cumberland, Md., makers of chemical yarns. Most of these ammonia compressors have been in use since 1929. The motors driving the new vertical machines, shown in the foreground, are each of 1250 hp.

This is a large-scale example of the dependability and economy of Frick ammonia refrigeration. Power requirements, when operating in summer weather on air conditioning loads, are only 0.70 hp. per ton of refrigeration.

The really important jobs, whether for air conditioning, ice making, or other commercial cooling work, call for FRICK refrigeration.





A "National" installation for American Cyanamid Co. plant at Bridgeville, Pa.

ASH REMOVAL the NATIONAL way assures you low-cost, dependable service

Are ash removal costs a factor in cutting your profits? We suggest a survey by a National engineer. It will cost you nothing. It may avoid wasted dollars.

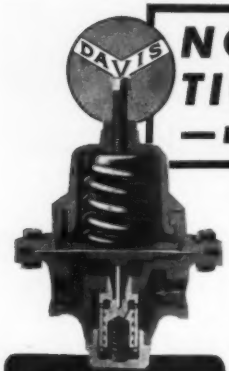
NATIONAL PNEUMATIC STEAM ASH REMOVAL SYSTEMS

save money in two ways –

1. Exceptionally easy one-man operation cuts labor cost to the bone.
2. Maintenance costs are surprisingly *low* because rugged NATIONAL construction results in maximum life for parts.

A complete and effective service policy and a reputation for delivering satisfaction are extras that go with NATIONAL installations.

NATIONAL CONVEYORS COMPANY, INC.
50 CHURCH ST., NEW YORK 7, N.Y.
Manufacturers of The National ChipVeyor System For Metal Turnings—Furnace Doors—Feeders—Ash Gates and Related Equipment.



NON-STICKING! TIGHT CLOSING! —no pressure build-up

DAVIS NO. 13 AUTOMATIC PRESSURE REDUCING VALVES

EXCLUSIVE DESIGN—
Single seated, tight closing, non-sticking. Large diaphragm, sensitive pressure adjustment. Compact, rugged, self-contained.

TROUBLE-FREE SERVICE—
Built-in strainer, finest quality, all internal parts readily accessible and renewable without disturbing piping. Long economical service with minimum time out for repairs or replacement.

FOR STEAM, AIR OR GAS—
For initial pressures to 250 p.s.i.; reduced pressures, 1 to 100 p.s.i. Sizes from $\frac{3}{8}$" to 2". Semi-steel bodies bronze or stainless trim. Economical for use on small units. *Write for literature.*

DAVIS REGULATOR CO.
Established 1875
2540 SO. WASHTENAW AVE. CHICAGO 8, ILL.

NOTES for the Power Engineer

C. H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM
PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

C. H. Wheeler CONDENSERS are self-cleaning by REVERSE FLOW

End Downtime for Cleaning Maintain Constant Full Load

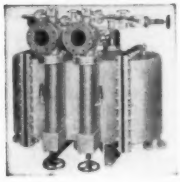
Now you can end your troubles with clogged tube sheets. No longer need you shut down a steam condenser while a conglomerate of refuse—vegetable, animal and mineral—is laboriously removed by slow hand methods.

C. H. Wheeler has developed a simplified method for *reversing* the flow of cooling water in either single or divided water box condenser designs. Rapid reversal of cooling water flow effects a sudden change in temperature which shocks and dislodges marine growth. The physical force of the water flushes this and all other debris, including sand and muck, down the discharge.

The self-cleaning reverse flow is accomplished in new C. H. Wheeler condensers by built-in valves or sluice gates. A push button performs the flow-reversing operation. What formerly took hours is now accomplished in a matter of minutes with no interruption in load.

If you don't need a *new*, integrally built, Self-Cleaning Condenser, C. H. Wheeler can apply the Reverse-Flow principle to other steam condenser installations by means of external piping and four-way valves. Your correspondence is invited. C. H. Wheeler is "Ahead in Condenser Development."

STEEL SHELL TUBEJET AIR EJECTORS MORE RELIABLE . . . SAVE SPACE



Engineers' fears of porous castings have led many to specify separate inter-after condensers with air ejectors. These fears are now totally dispelled with the new C.H. Wheeler Steel Shell Tubejet Air Ejectors. Designed originally to attain compactness for marine installations, thousands of these ejectors rendered outstanding service in World War II. This streamlined version of the older design effects considerable savings in space and weight. They are being widely adopted for stationary power plant use. Available with either single or multiple element, two-stage type with combined surface inter-after condenser. The coupon will bring you Specification 88, just released. It shows preferred method of piping to control hotwell level in main condenser.

THIS NEW CATALOG WILL BRING YOUR CONDENSER INFORMATION UP-TO-DATE

C. H. Wheeler Mfg. Co.,
1800 Sedgley Ave., Philadelphia 32, Pa.

Name .....

Department .....

Company .....

Address .....

Please mail me file material on C. H. Wheeler

☐ Self-Cleaning Condensers ☐ Tubejets (Specification 88)

C. H. WHEELER MANUFACTURING CO. 1800 SEDGLEY AVE. PHILADELPHIA 32, PA.

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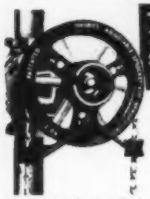
Control Valves from the Floor



Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

ELIMINATES
STEP-LADDER
CLIMBING
RISKS

● Range of 10 adjustable sizes take care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

● Climbing on benches, machines, boilers or treacherous stepladders to control overhead valves is absolutely unnecessary, foolish risking of life and limb. Why permit such risks when the safe and sure BABBITT Adjustable Sprocket Rim with Chain Guide is available at such low cost? Overhead valves are conveniently and safely operated right from the floor!

● The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

● *Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.*

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1 Babbitt Square, New Bedford, Mass.

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formerly associated with L. J. Land, Inc., of New York and Reading

Announces the Purchase of

American Electric Co.
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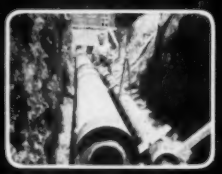
where he will specialize in
Odd Voltage Direct Current and
Variable Voltage
Motor Generator Sets

●

Your inquiries for (and listings of) new and rebuilt Motors, Generators, and Transformers are respectfully invited.

For
TOP EFFICIENCY
INSULATED PIPING SYSTEMS



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For distribution of steam or hot water, oils or process liquids, Ric-wiL Prefabricated Insulated Piping will provide your piping system with maximum sealed-in protection and efficiency.

Architects, engineers, and contractors have long recognized the reliability of Ric-wiL engineering and manufacturing of high-efficiency insulated piping—factors that insure long trouble-free life of industrial, commercial, and residential piping systems.

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HENSZEY
PACKET-TYPE *Automatic* CONTINUOUS BLOWDOWN

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(with simple chemical treatment)

This compact self-contained unit is completely assembled. Can be installed by your own men in hours. It provides completely automatic control of boiler water concentration regardless of variations in boiler load. This is accomplished WITHOUT HEAT LOSS. Maintain clean efficient boilers for substantial savings in fuel, equipment and manpower.

Also...
Standardized or special units for ALL CAPACITIES.

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CONTINUOUS BLOWDOWN and BOILER PLANT SPECIALTIES
Boiler Feed Regulators • Distillation Systems • Heat Exchangers • Feed Water Meters
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SAFETY
BS&B
HEADS

It Can Only Fail SAFE

...from overpressure within pressure systems

The heart of a BS&B Safety Head is the rupture disc...and it provides the only kind of "heart-failure" that means life and continued healthy operation. The safety disc's "heart-failure" is the controlled weakness BS&B built into it for your protection – for the safety of your personnel, your property, and your valuable equipment.

You give us the necessary operating information. BS&B will give you a safety head – with a heart – that will always fail safe – within plus or minus 5% of the pre-determined pressure specifications for safety. This we can guarantee; for discs are rated and checked by actual rupture tests. First, the metal is selected for fabrication to specifications of any given lot of discs. Then discs are selected at random, and tested to destruction after the lot is completed. If each one tested does not break within 5% of the rated pressure *the entire lot is discarded.*

To the many industries requiring pressure vessels and accessories, BS&B is well known for its research and fabrication in this field. For example, we have solved the behavior problems of metals where safety head discs are concerned. In the BS&B plant you'll find the largest selection of thin ductile metals in the world ever assembled in one place. This enables us to fabricate over 95% of all rupture disc orders from materials on hand.

BS&B Safety Heads can be used for primary relief wherever maximum protection is required ... or for secondary relief to back up a relief valve whenever the contents of a vessel or system may prevent the valve from functioning properly. It provides full pipe-sized unrestricted opening. Rupture discs are available within a range of 5 lbs. to 40,000 lbs. The fail-safe action of BS&B Safety Heads is fast, positive, accurate . . . whether your pressure applications are for air, gas or liquids – bland or corrosive. They're code-accepted.

Never be too sure about safety. *WRITE TODAY* for complete BS&B Safety Head Catalog and complete details. There is no charge or obligation for a complete analysis of your pressure safety requirements.

SAFETY
BS&B
HEADS

BLACK, SIVALLS & BRYSON, INC.

DEPT 2-Q4

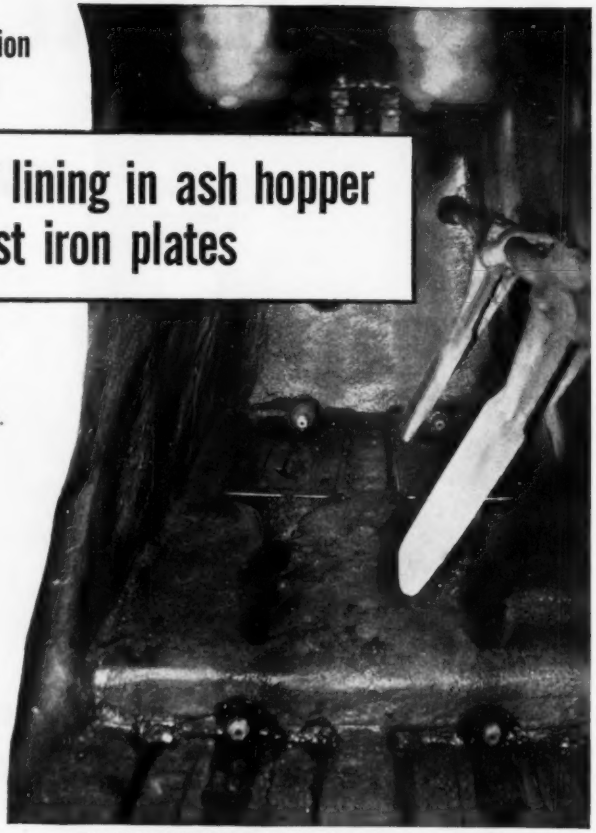
7500 EAST 12TH STREET KANSAS CITY 3, MISSOURI

Westinghouse Electric Corporation finds that...

Low-cost LUMNITE* lining in ash hopper outlasts cast iron plates

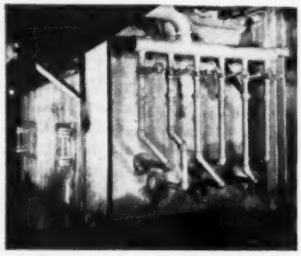
Instead of replacing cast iron plates on this ash hopper, Westinghouse engineers simply specified a 2" lining of Heat and Corrosion-Resistant Concrete made with Lumnite cement. They've found it does a job fast . . . costs *far less* than new plates . . . and lasts much longer. In fact, they're so well pleased with Lumnite they now use it to line all their ash hoppers.

Does their experience with Lumnite cement suggest profitable uses to you? It's proved to be a better way to line stacks, breechings and flues . . . make coal bunkers, ash pits . . . cast door linings, water wall studding and baffles, and make many fast repairs. Concrete made with Lumnite calcium-aluminate cement reaches service strength within 24 hours. With appropriate aggregate it withstands heat of 2600°F. or more, and it's highly resistant to abrasion, corrosion and thermal shock.



THIS GIANT ASH HOPPER at the East Pittsburgh, Pa., power plant of Westinghouse got its durable lining of Lumnite concrete in a hurry. Lining was simply shot on with a cement gun.

CAST IRON PLATES on this ash pit were a major maintenance item—until Westinghouse used Lumnite concrete linings as in top photo.



LININGS made with Lumnite proved so successful, Westinghouse engineers specified Lumnite for this all-concrete ash hopper at the Trafford, Pa., Power Plant.

FOR CONVENIENCE in making Refractory and Insulating Concrete, you may prefer to buy prepared Castables. These packaged mixtures of Lumnite and selected aggregates are tailor-made to meet your specific temperature and *insulation* requirements. Add only water. They are made by refractory manufacturers and sold through their dealers.

For complimentary booklet on the many uses of time- and-money-saving Lumnite write: Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

*"*LUMNITE" *is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

P-L-64

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

revolutionary new KEY-KAST alloy welding fittings assure longer life for piping systems!

1. Greater wall thickness throughout—for increased structural strength.

2. Extra thickness in critical areas —for greater allowance against corrosion and erosion.

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Produced in all shapes . . . sizes . . . schedules.

Available in low and intermediate alloys and various stainless steels.

Bosses provided on all fittings for tapped openings.

Controlled quality . . . through rigid metallurgical control. Produced, inspected and tested in one plant.

Lower unit cost.

Meets A.S.M.E., A.S.T.M., and A.S.A. codes

PROMPT DELIVERIES! Wire or write for information today.

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GET THE FACTS! Send for your copy of the Key-Kast Welding Fitting Bulletin. (Please make request on your letterhead).

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Just another modern High Pressure-High Temperature Power Plant in the Southwest that has DEPENDABLE Piping.
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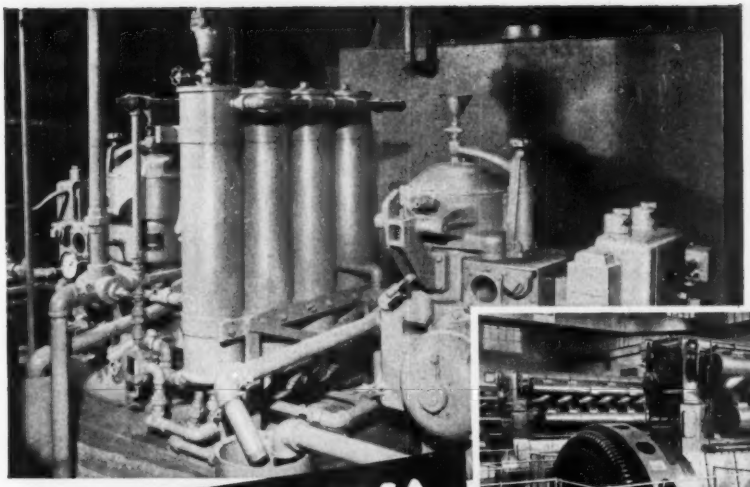
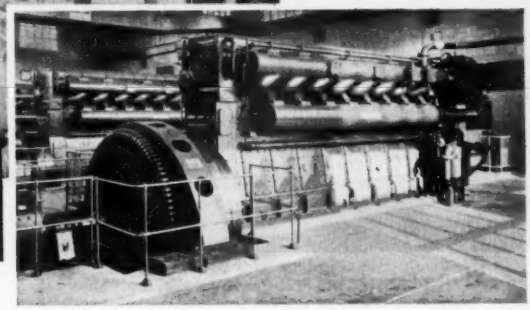




AT OWL'S HEAD—

This De Laval "Puri-Filter" Keeps the Lube Oil CLEAN

To remove all three major contaminants of diesel lubricating oil, Owl's Head uses the De Laval "Puri-Filter." The first two troublemakers — dirt and water — are separated from the oil by centrifugal force. The dirt is stored against the periphery of the bowl where it can not again mix with the oil, and the water is discharged continuously to waste. The third contaminant — colloidal carbon — is filtered out of the purified oil by the filters.

This combination of a De Laval "Uni-Matic" Oil Purifier and a Fram "Filcron" Filter is a completely piped-up unit that is so effective that it gets rid of all solid impurities down to approximately one micron in size. It is by all odds the most effective means ever devised for protecting diesel engine bearings.

Bulletin DL-1 gives additional details. Write for your copy.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

for most dependable power production

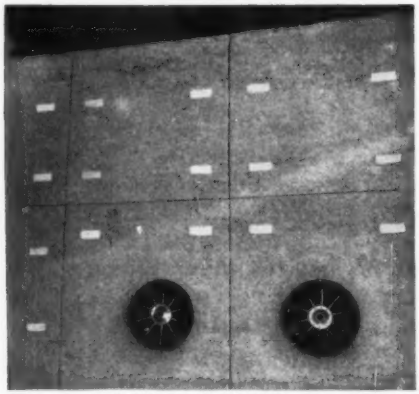
LUBRICATING OIL PURIFIERS

A. P. GREEN
Plastic Firebrick

GIVE LONGER, TROUBLE-FREE SERVICE . . . OFFER YOU 5 ADVANTAGES

1. JOINT-FREE FURNACE LININGS
   present a solid monolithic front to slag and furnace gases.
2. ELIMINATION OF AIR INFILTRATION
   lowers fuel cost and increases efficiency.
3. ADAPTABLE TO ANY THICKNESS OR CONTOUR
   eliminating need for special refractory shapes.
4. FREEDOM FOR EXPANSION AND CONTRACTION
   with A. P. Green floating anchors.
5. "ZONE-RATED" TO DO THE JOB
   Plastics with properties to meet conditions in various zones of the furnace.

A. P. GREEN PLASTICS are firebrick in plastic, moldable form . . . shipped ready to install. Plastics are used for one-piece, monolithic linings and patching material in all types of boilers and industrial furnaces.



A. P. Green plastic firebrick lining in 821 h.p. water tube boiler. Plastic, air-cooled, sectionally supported walls were used throughout the furnace section.

The large warehouse stocks maintained by our distributors, plus their experienced engineers and installation men, are your assurance of the most advanced refractory service available.

For additional information, write for our Plastic Firebrick Folder, or call your local distributor . . . he's listed in the yellow pages of your telephone directory.

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Mexico, Missouri, U. S. A.
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Toronto 15, Ontario

3 TYPES TO MEET SPECIFIC REQUIREMENTS

SUPER-PLASTIC

1. Super duty plastic made from finest Missouri flint fire clays—gives exceptional service . . . particularly in furnace sections most subjected to wear as a result of high temperatures, slagging, or load under soaking heat. Superior in resistance to high temperatures, spalling, slagging, and excellent in load bearing strength.

SUPER HYBOND

2. Special super duty plastic that develops high strength throughout its entire thickness . . . regardless of furnace operating temperatures or total thickness of the lining. The back or cool portion against casing will form strong bond when enough heat has been applied to dry the plastic.

PLASTIC QUIK-PAK

3. High duty plastic made from first quality Missouri fire clays. Excellent in resistance to spalling . . . high load bearing strength . . . low service shrinkage. Specify for complete monolithic furnace linings and patching material for quick repairs . . . where furnace conditions do not require a super duty plastic.

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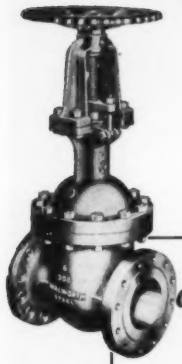
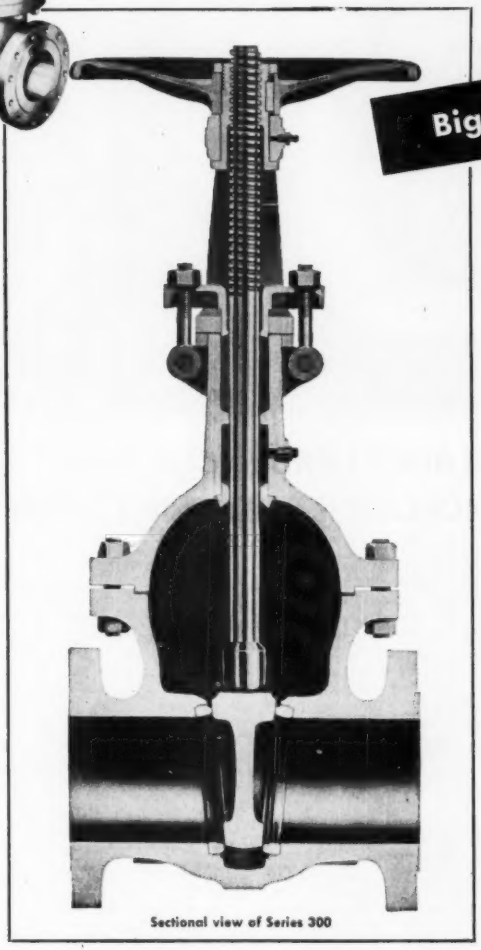
Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

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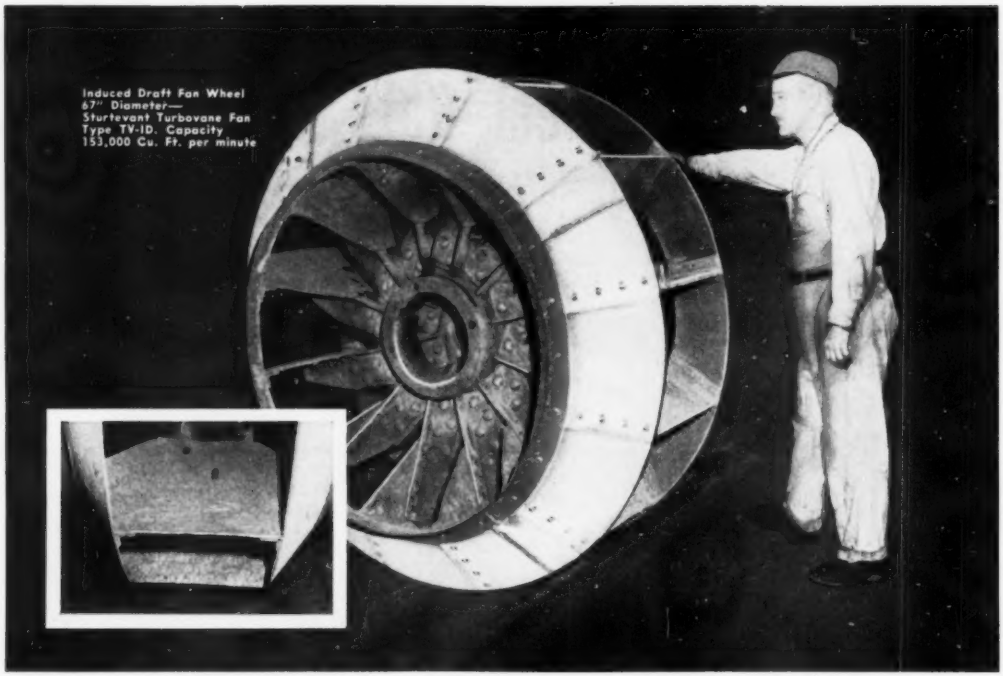


LIFE OF ID FAN BLADES HARD-FACED WITH COAST METALS ALLOY INCREASED FROM 4 to 12 MONTHS

2 Weeks Boiler Outage Eliminated With CM-112 Alloy

Maintaining this 67" induced draft fan wheel at New Jersey Power & Light Company's Gilbert Station in Holland, N. J. always meant one week of boiler outage three times a year. Labor involved in removing the wheel, changing over and reblading took two weeks for each overhaul. Now this is done only *once a year* by hard-facing the fan blades with Coast Metals Alloy 112. This has reduced downtime better than 66% and eliminated 2 weeks of boiler outage at the station.

Fly ash in the exhaust handled by the fan not only wears down the blades but also attacks the junction points of the blades and shrouds weakening the assembly. In this severe case of abrasive action, CM-112 applied to the major points of wear has increased equipment life better than 3 to 1. Coated with 250 pounds of CM-112, the fan lasts one year before major overhaul. Minor touchups during the year are made while the fan wheel remains in the housing . . . on the job.

After one year of operation, the fan wheel can be refaced again . . . this time with about 60% less than the amount of CM-112 used in the initial hard-facing, resulting in a further reduction in maintenance costs.

There are many other examples of how CM Alloys extend the life of power plant equipment subject to impact and abrasion: Raymond Bowl Mill parts—coal feeder screws — sluice liner castings — clinker crusher rolls—impact mill plows—ID fan float liner plates, exhauster fan blades, when hard-faced with CM *stay on the job* and continue to perform efficiently *long after* unfaced parts have become too worn to use and must be replaced.

So don't *replace — reface* with CM specialized welding rods. You'll not only keep your plant running with fewer interruptions, but save money. We shall gladly make recommendations based on your particular needs.

COAST METALS, Inc.

Little Ferry, N. J.

COAST METALS (CANADA), LTD., Hamilton, Ontario

PRODUCERS OF SPECIAL HARD-FACING ALLOYS FOR THE POWER INDUSTRY

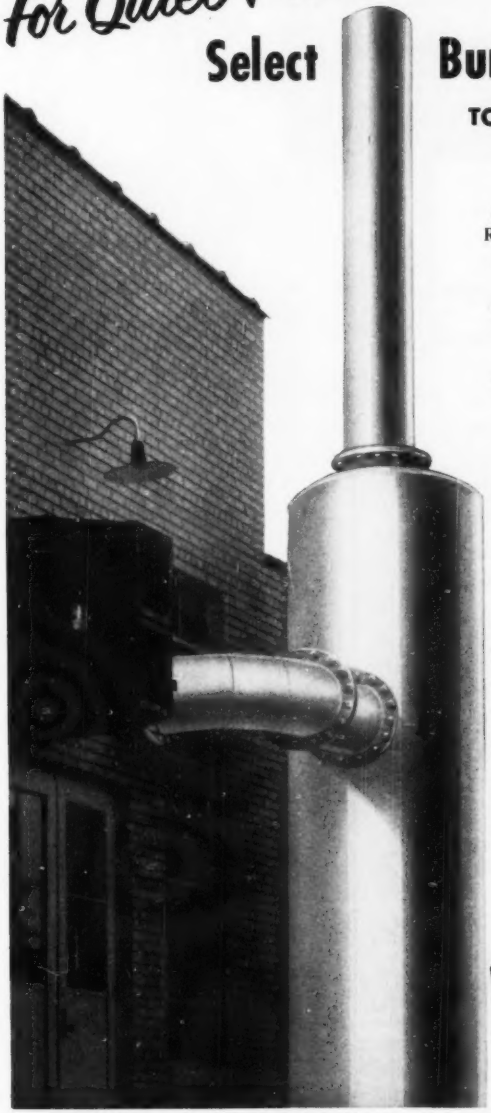
For Quiet Power Plant Operation

Select Burgess-Manning Snubbers

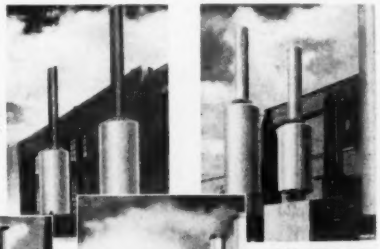
TO ELIMINATE ENGINE EXHAUST NOISE

Experienced management recognizes that quiet plant surroundings are essential for maintaining good public relations in their communities. Reliable Burgess-Manning Snubbers, for Diesel-electric power plants, are ideal for effectively reducing the annoying roar of engine exhausts to the noise level of the surrounding area.

To reduce engine exhaust noise without interference with efficient engine operation . . . for quiet surroundings . . . install Burgess-Manning Snubbers.

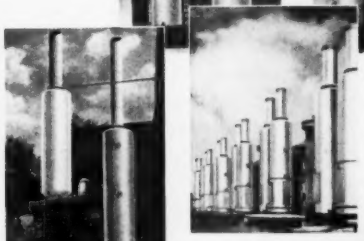


Municipal Diesel-Electric Power Plant, Sabina, Ohio, equipped with Burgess-Manning Exhaust Snubbers.

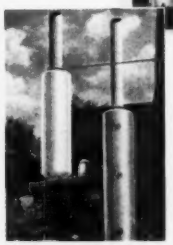


Iowa Power Plant equipped with Snubbers.

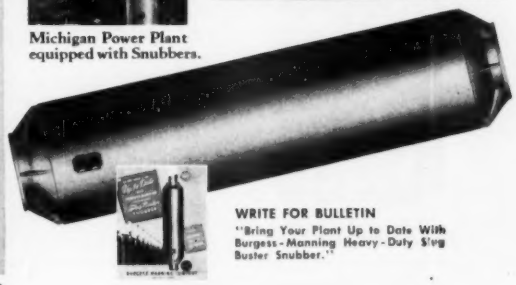
Ohio Municipal Light Plant equipped with Snubbers.



Mexican Power Plant equipped with Snubbers.



Michigan Power Plant equipped with Snubbers.



WRITE FOR BULLETIN

"Bring Your Plant Up to Date With Burgess-Manning Heavy-Duty Style Buster Snubber."

BURGESS-MANNING COMPANY

Dallas, Texas • 749-J East Park Ave., LIBERTYVILLE, ILLINOIS • Chicago, Illinois

FOR LOW-COST MAINTENANCE with the greatest of ease!

See how Darling cast steel gate valves save you time and money!

YOU know how important low-cost, *easy* maintenance can be. It's one of many Darling Valve features worth shouting about.

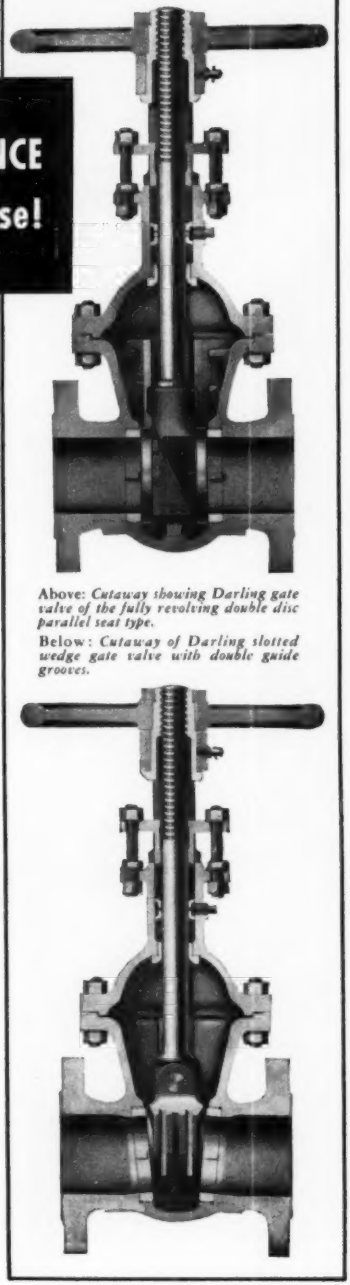
For example, all *Darling* parts are precision-made to jigs and templates. Replacement parts slip in quickly and easily.

What's more, Darling valves are designed so that seat rings and all working parts are easily removed and replaced without taking the valve bodies from the line.

These maintenance and repair advantages, plus many other time-and-money-saving features, apply to Darling gate valves of both popular types shown at right. It adds up to low-cost performance at its over-all *best!* Ask for the Darling Cast Steel Valve Bulletin. Get *all* the facts so you can judge for yourself!

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

FOR EVERY NEED. *Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.*



Above: *Cutaway showing Darling gate valve of the fully revolving double disc parallel seat type.*

Below: *Cutaway of Darling slotted wedge gate valve with double guide grooves.*

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

1...2...3...4... 5...6...7...8 Big Reasons

why the

B & G 1522 *Hydro-Flo* PUMP

will better satisfy

your pumping needs

Plant engineers and maintenance men are astonished at the performance of the B & G 1522 Pump . . . because this unit licks the pumping jobs which usually cause trouble. For these reasons—

First: Leak-proof Mechanical Seal—ends stuffing box troubles.

Second: Spring-type flexible coupling—contributes to unusually quiet operation.

Third: Hydraulically balanced impeller.

Fourth: Easily serviced. Removal of a few bolts permits separation into three parts.

Fifth: Interchangeable parts. The bearing bracket subassembly, including shaft and sleeve bearings, is manufactured to close tolerances and is interchangeable in all 1522 Pumps.

Sixth: Shaft alignment maintained by extra long, oil-lubricated, high-grade bronze sleeve bearings.

Seventh: Standard motors—easily obtainable from motor manufacturer's local stocks.

Eighth: With all these features B & G 1522 Pumps are *competitively priced!*

B & G Series 1522 Pumps are available in all-iron, bronze-fitted, all-bronze and stainless steel units. Capacities to 130 GPM—heads to 115 ft. Write for catalog CY-350.

B&G

BELL & GOSSETT

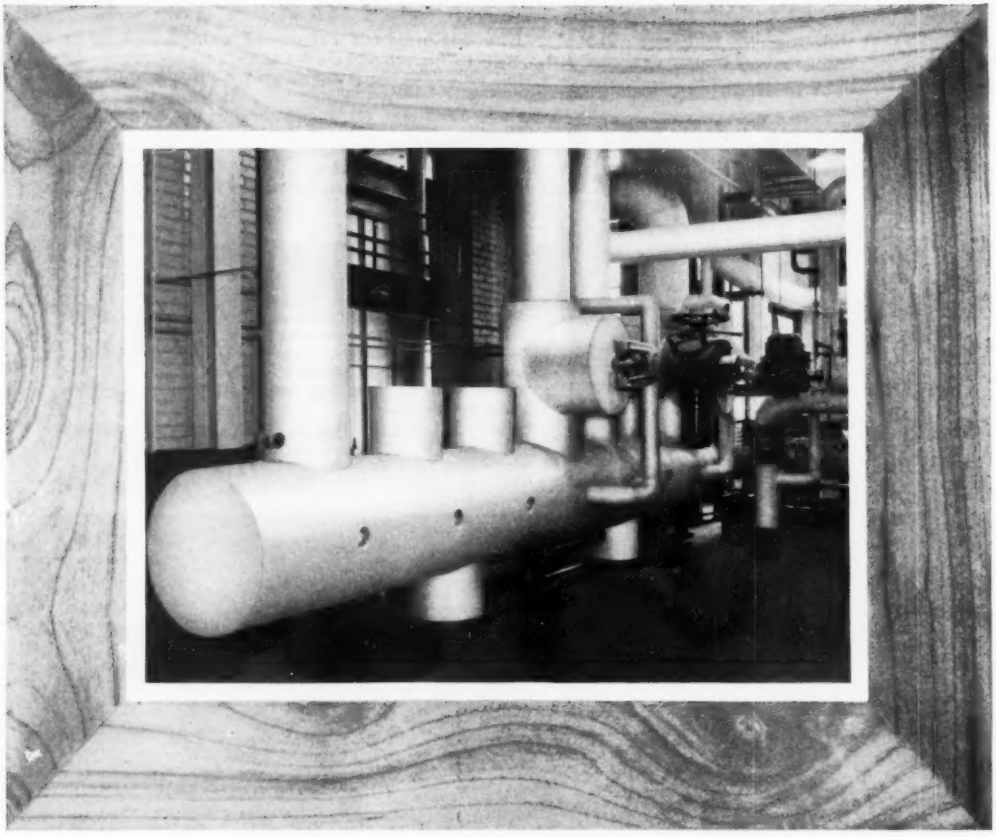
COMPANY

Dept. CL-36, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

HEAT EXCHANGERS — FORCED HOT WATER HEATING SYSTEMS — WATER HEATERS — REFRIGERATION EQUIPMENT

*Reg. U. S. Pat. Off.



Insulation Contractor: Guy M. Beaty & Co., Charlotte, N.C.

Steam header at Cannon Mills Co., Kannapolis, N.C., insulated with K&M Hy-Temp and "Featherweight" 85% Magnesia Combination, finished with sewed canvas jacket.

PORTRAIT OF STEAM HEADER AT 750° F.

clothed for life . . . . with K&M Insulations

YOU SEE here one of the most efficient combinations you can get today for lifetime protection against heat loss—K&M Hy-Temp Insulation teamed up with "Featherweight" 85% Magnesia.

You can use the same combination, in appropriate thicknesses, for efficient insulation of temperatures from 600° F. up to 1900° F.

K&M Hy-Temp Insulation is applied directly to the high temperature surface in sufficient thickness to lower the temperature of the outer surface of the insulation to 600° F. or less. "Featherweight" 85% Magnesia, which has a higher insulating value, is then applied directly over the Hy-Temp Insulation, thus utilizing the advantages of both insulations to the fullest extent.

These insulations are supplied in appropriate forms and thicknesses for application to equipment surfaces and piping.

Your local K&M distributor, who is an experienced applicator, will give you full information. Or write us direct . . . we'll rush a reply.

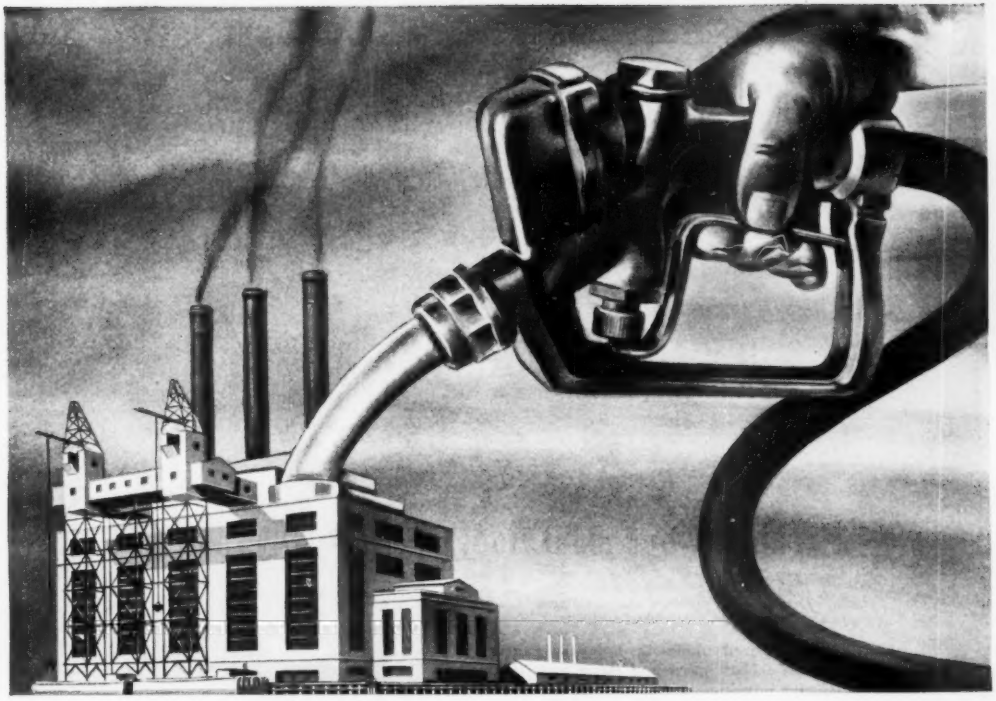
Nature made Asbestos . . .

Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

In Canada: Atlas Asbestos Co., Ltd., Montreal, Toronto, Winnipeg and Vancouver.



Refill For Plants That Need More "GO"

Are increased production loads demanding more than your plant can deliver? Here's how a power company we know tackled this problem. The approach used may help you, too.

In their case, demands called for such increases that a new station was needed. And because the area was so densely populated, tight operating economy was as much a "must" as peak productivity.

The boiler designed to meet these needs was built to deliver over a million pounds of steam an hour. In this design, steam scrubbers and cyclone separators literally cleaned the steam to protect superheaters from impurities that cause overheating and corrosion, and to help turbines keep peak efficiency. By making possible greater water level variations, in addition, this boiler permits larger, faster, *safer* load swings, while other new features assure longer life, lower operating costs, more power.

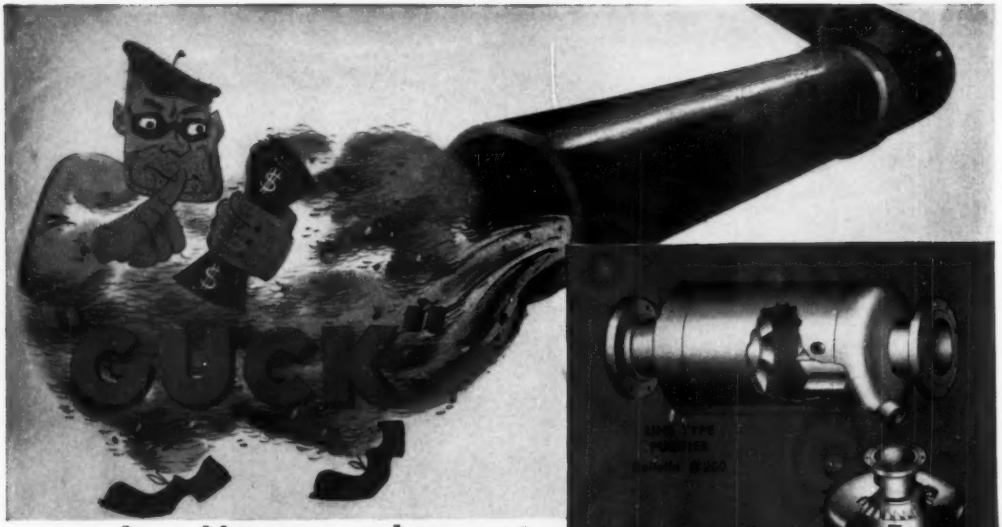
What *approach* assures equipment advances like these? Combined planning by engineering staffs of progressive Equipment Builders working with power engineers and materials suppliers. And for its knowledge of materials—as well as the design freedom, strength and rigidity of its specialty steel plate, heads and shapes—such builders turn to Lukens regularly.

Would you like them to help you? For their names, write us today, explaining your need. Manager, Marketing Service, Lukens Steel Company, 585 Lukens Building, Coatesville, Pennsylvania.

LUKENS

LUKENS STEEL COMPANY

WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PLATE • PLATE SHAPES • HEADS • CLAD STEELS



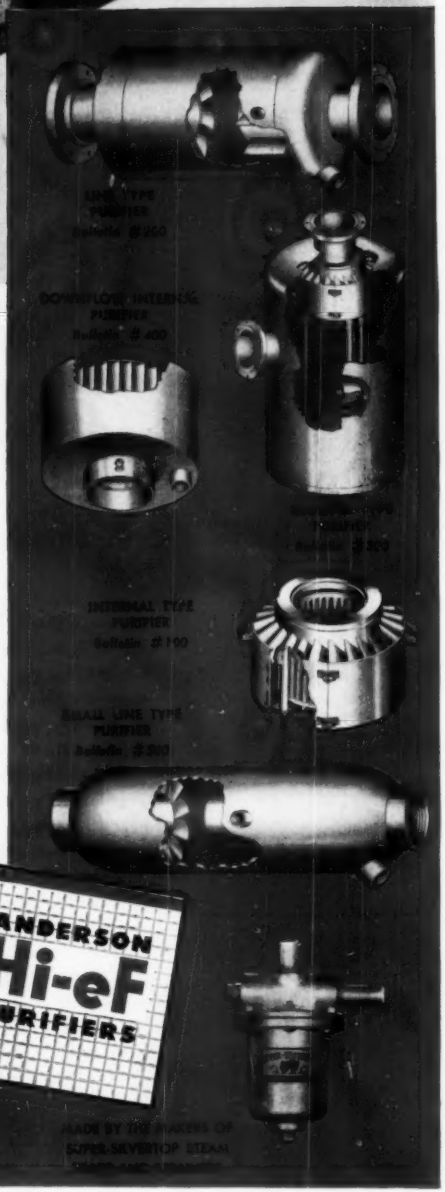
may be robbing your plant, too!

Guck is sludge, oil, line scale and other objectional entrainment in pipelines and equipment handling steam vapor, compressed air or gases.

For years "guck" has been robbing the industrial plants of America! Guck in exhaust gases and steam fouls costly equipment, causing downtime, increased maintenance and reducing efficiency. Guck in many cases makes exhaust steam so objectionable that it cannot be reclaimed. Guck vented with spent gases and vapors damages plant equipment and buildings.

Anderson Hi-eF Purifiers are the one sure way of ending not only "guck" but all steam and vapor entrainment problems. They clean up compressed air and steam lines, protect production and steam equipment, stop nuisances from vented gases and steam. In processing plants they economically reclaim the valuable solids in gases and vapors arising from the materials as it is processed.

The unique centrifugal element design of Anderson Hi-eF Purifiers is guaranteed to remove 99% of entrained liquids, solids, condensate, oil and greases from live and exhaust steam, processed gas, air and chemical vapors. These units cost much less than you might expect . . . require no maintenance . . . are self cleaning . . . and last a lifetime. If you you have a "guck" problem write to Anderson. Our engineering staff, with an impressive background of purifier experience, will gladly solve your problem.

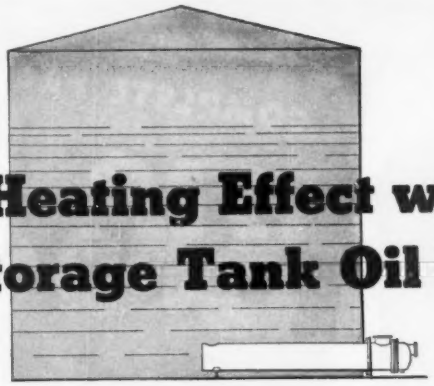


PURIFIER DIVISION,
THE V. D. ANDERSON COMPANY
1934 West 96th Street • Cleveland 2, Ohio

Gentlemen: Please send additional information on Anderson Hi-eF Purifiers described in:

☐ Bulletin #100 ☐ Bulletin #300 ☐ Bulletin #500
☐ Bulletin #200 ☐ Bulletin #400

Name .....
Company .....
Address .....
City ..... Zone ..... State .....

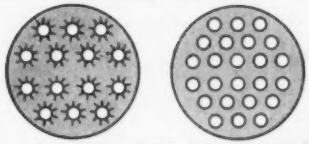


Greater Heating Effect with the G·FIN Storage Tank Oil Heater

because....

1.

Greater Access of Oil to Heating Elements



At left is a tube sheet of a G-R finned-tube heat exchanger. At right is a tube sheet of a typical bare-tube heat exchanger. Note the greater access space between tubes in the G-R exchanger.

2.

Greater Heating Surface of G·FIN Elements

Even in sub-zero temperatures, the G-R G-Fin Storage Tank Oil Heater assures a steady flow of oil soon after the steam is turned on. That's because (1) the wider tube spacing allows the viscous oil greater access to the tubes than in a conventional heater and (2) the G-Fin elements provide six to eight times the heating surface of bare tubes.

Greater heating effectiveness is only one of the important reasons why users prefer the G-R G-Fin Storage Tank Oil Heater. These units use less steam because they heat oil only locally at point of withdrawal. The straight-through flow of oil results in minimum pressure drop. There's no stratification or vapor binding because the oil outlet is located at the top of the shell. And there are fewer tubes and tube joints to maintain.

These and other advantages of the G-Fin Storage Tank Oil Heater have been fully proved in thousands of installations. Write for Bulletin describing these units in detail.

TYPICAL APPLICATIONS OF G-R G-FIN STORAGE TANK OIL HEATER

STORAGE TANKS—containing heavy oils, tar or asphalt at refineries, tank farms, etc.

SERVICE TANKS—serving oil-burning boilers at central power stations, industrial plants.

LOADING WHARVES—to speed up transfer of oil to and from tanks, lighters, barges or cars.

CHEMICAL PLANTS—wherever viscous oil or other liquids must be transferred in bulk.

GAS PLANTS—where by-product tar or heavy oils must be heated.

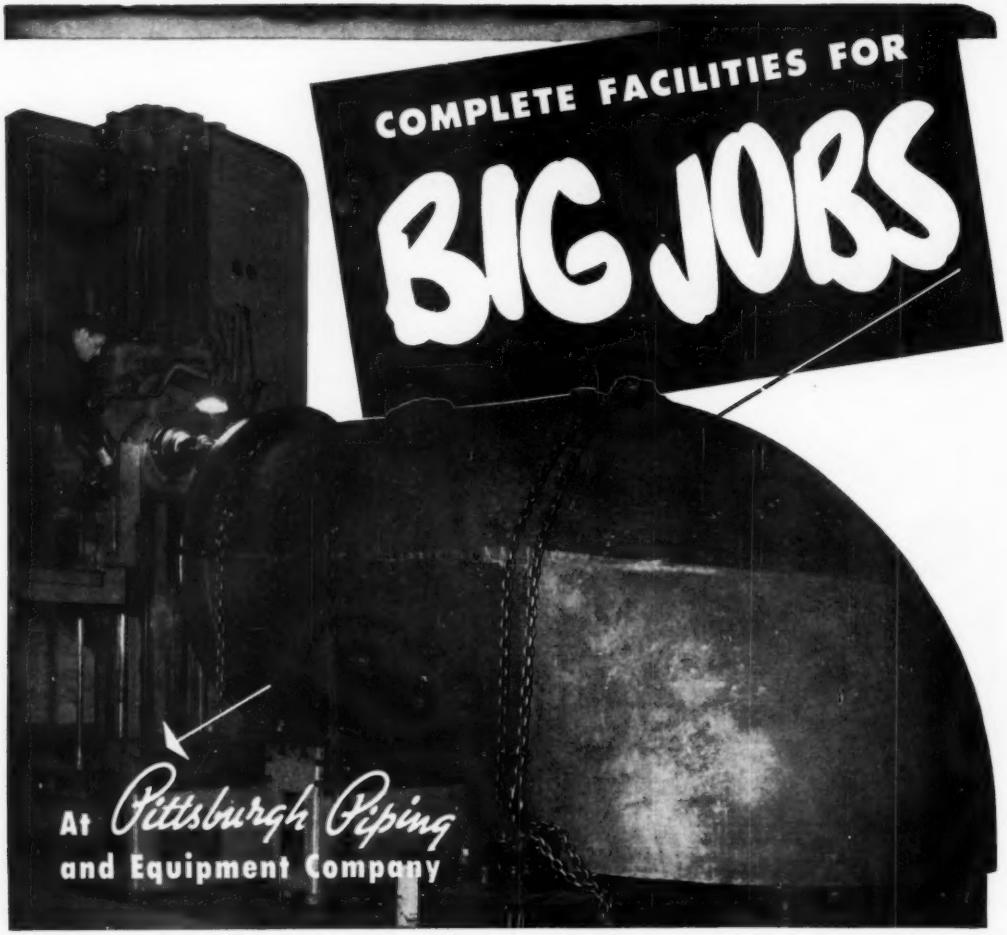
MISCELLANEOUS—for heating cottonseed oil, molasses, road oil and other viscous liquids.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR-223

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS



Machining a casting of this size requires special equipment—big equipment for handling big jobs.

Actually, this casting is small compared to the complex piping systems that are planned, prefabricated, and tested *under one roof* at Pittsburgh Piping and Equipment Company.

At P.P.&E. all facilities are integrated . . . engineering, metallurgical and mechanical laboratories, bending, Van Stoning, machining, heat-treating, stress-relieving, testing.

Because our manufacturing personnel and equipment are all under the roof of one great plant—our complete know-how, experience, and facilities are constantly available on every job.

This is another reason why you can depend upon Pittsburgh Piping and Equipment Company for service that provides greatest safety, highest efficiency, and longest life from high temperature, high pressure piping.

Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street — Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston

"Buffalo" *Tips on Better Pumping*

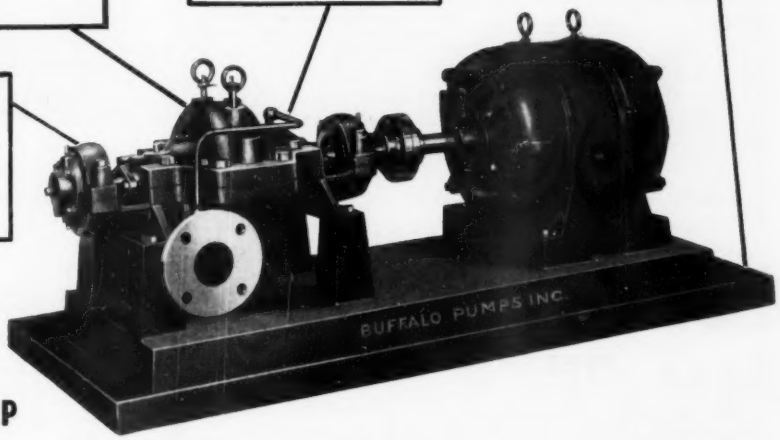
What To Look For In Choosing A Clear Water Pump

EFFICIENT ENCLOSED IMPELLERS— Built to develop required pressures.

DEEP STUFFING BOXES— large enough in this 2-stage pump to hold 7 rings of packing on each side of impellers.

RUGGED OVERALL CONSTRUCTION— including shaft, couplings, glands and wearing rings.

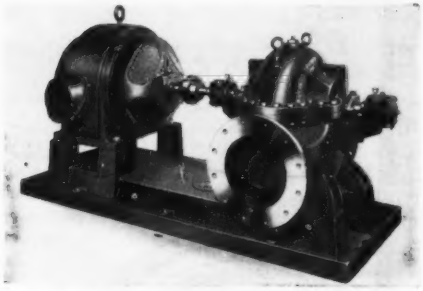
ADEQUATE BEARINGS— ball bearings, Bearings on both sides of impeller as in this pump.



"Buffalo" TYPE "RR" PUMP

This "Buffalo" Pump is built in both 2- and 4-stage models for handling clear water at pressures as high as 500 pounds, any temperature. A highly efficient pump, it is widely used for boiler feed service. Like every "Buffalo" Pump, it is given a complete test run under actual expected operating conditions before shipment to the customer. If you are interested in a clear water pump that will give you lifetime service with a minimum of trouble and attenton, specify an "RR".

For complete data on "RR" Pumps, request Bulletin 980-C and for information on "SL" Pumps, let us mail you Bulletin 955-P.



"BUFFALO" TYPE "SL" PUMP

The Pump specified for many of the best-known air washers and air conditioning systems including chilled water service, the "Buffalo" Type "SL" Double Suction Pump is one of our best built models, and is available in capacities from 10 to 10,000 gpm.

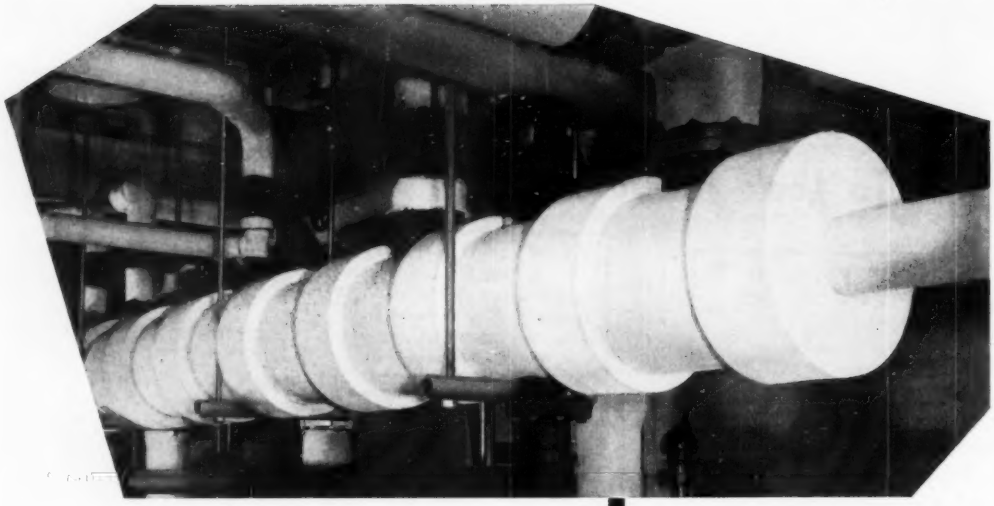
"Buffalo"

BUFFALO PUMPS INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



MAKE TOUGH JOBS EASY
WITH EASY-TO-USE

UNIBESTOS®

PIPE INSULATION

Ask any user about Unibestos! He'll tell you how easily this good insulation is cut and fit on-the-job, for Unibestos is light, strong, firm—saws cleanly for tight joints—retains initial high efficiency. It is unaffected by service hazards.

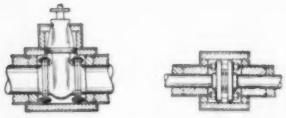
Whether you specify Unibestos No. 1200 (for temperatures up to 1200°F.), Unibestos No. 750 (for temperatures up to 750°F.), or Amocel for commercial uses (temperatures up to 600°F.), you'll always save in two ways: (1) quick and simple application; (2) long-lived durability. Your Unarco Distributor can supply you quickly from his stocks of these pipe insulations. Also available in block form for temperatures up to 1200°.

For details on these insulations, ask for Bulletin No. 76-109.

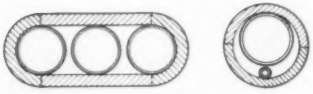
UNARCO

Write for the name of the Unarco Warehousing Distributor in your area.

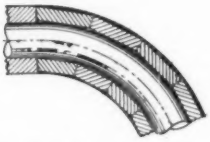
SEE HOW THESE TYPICAL APPLICATIONS ARE SIMPLIFIED



Unibestos pipe insulation is particularly adaptable for insulating irregular surfaces such as flanges, valves, and fittings. Its firmness and easy-to-fit characteristics make such jobs easy; save time.



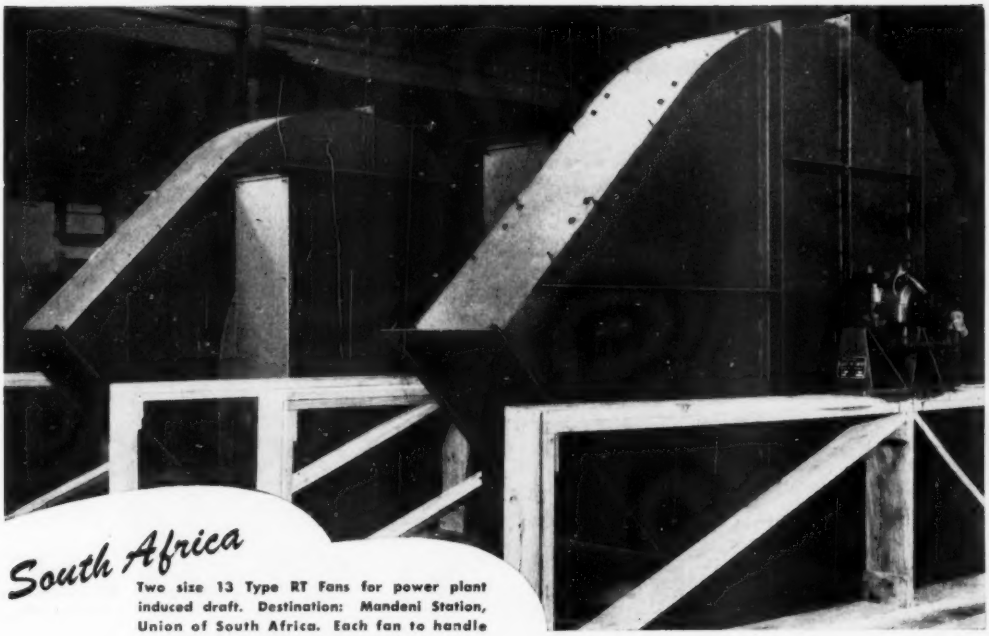
Unibestos pipe insulation and block can be used separately or in combination for insulating nested and traced lines quickly and economically.



For insulating pipe bends Unibestos can be mitered easily, and cemented-in with Unarco No. 50 insulating cement.

UNION ASBESTOS & RUBBER COMPANY

DEPT. C-4 · 332 SOUTH MICHIGAN AVENUE · CHICAGO 4, ILLINOIS



South Africa

Two size 13 Type RT Fans for power plant induced draft. Destination: Mandeni Station, Union of South Africa. Each fan to handle 48,300 c.f.m. of flue gases at over 500° F.

Clarage HEAVY-DUTY Induced Draft Fans Travel a Long Way to Make Good

SEND FOR CATALOG 901

Type RT Fan specifications and equipment arrangements for induced draft, forced draft and industrial air handling services are covered in this catalog. Write for your copy today.

Shipped five months ago, these Type RT Fans are now in operation almost halfway around the world from Clarage service . . .

But whether you are 50 miles from us — or 10,000 — makes little difference when you install Type RT fan equipment.

Every RT fan part — wheels, bearings, shaft, housing — is HEAVY-DUTY construction. You are not likely to need repair parts for a long time to come!

That is why this excellent mechanical draft equipment is now operating in 43 states and 15 foreign countries.

YOU CAN RELY ON

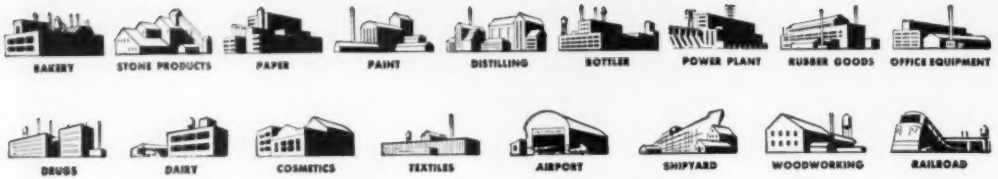
CLARAGE

HEADQUARTERS FOR AIR HANDLING & CONDITIONING EQUIPMENT

Clarage Fan Company 615 PORTER STREET **KALAMAZOO, MICH.**

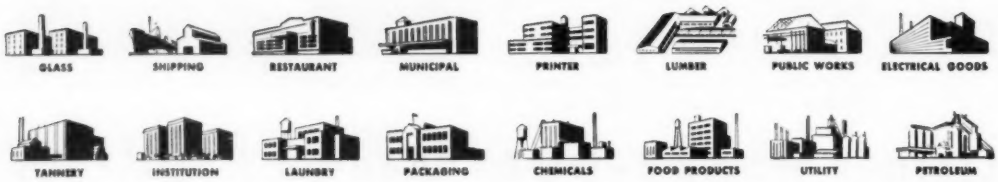
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



TODAY...

We're all in the steel business!



FOR EACH OF US TO *GET* MORE STEEL . . . AND PRODUCTS MADE OF STEEL . . .
WE'VE GOT TO *PROVIDE* MORE SCRAP TO *MAKE* THE STEEL.

Half the melting stock used in the steel mill or iron foundry consists of iron and steel scrap. In normal times, enough scrap is produced by the mills, foundries, railroads, fabricators and scrap dealers to fill the need.

But now the mills have stepped up capacity to meet the greatly increased military and civilian demands for steel. And that increased capacity has outstepped the supply of scrap.

That is why we are calling on plants in both metal-working and NON-METAL-WORKING industries to provide the needed scrap NOW.

You have the heavy scrap needed to make more steel

Enough obsolete machinery, equipment and parts are being carried as useless inventory to give a big push to the production of steel. Surveys have proved this.

The trick is to get that old steel into the hands of the steel producers.

We're putting that job up to you.

To help maintain steel production... provide more steel for the equipment you want . . . turn in your idle iron and steel to your local scrap dealer.

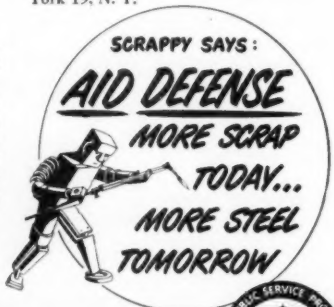
What you can do to help maintain steel production

1. Appoint one top official in your plant to take full responsibility for surveying the plant and getting out the scrap.

2. Consult with your local Scrap Mobilization Committee about its program to help out in the scrap crisis. For chairman's name, check with your Chamber of Commerce, or the nearest office of the National Production Authority, Department of Commerce.

3. Call in your local scrap dealer to help you work out a practical scrapping program. Non-ferrous scrap is needed, too.

4. Write for free booklet, "Top Management: Your Program For Emergency Scrap Recovery", addressing Advertising Council, 25 W. 45 St., New York 19, N. Y.



This advertisement is a contribution, in the national interest, by

McGRAW-HILL PUBLISHING COMPANY, INC.

330 WEST 42nd STREET, NEW YORK 36, N. Y.

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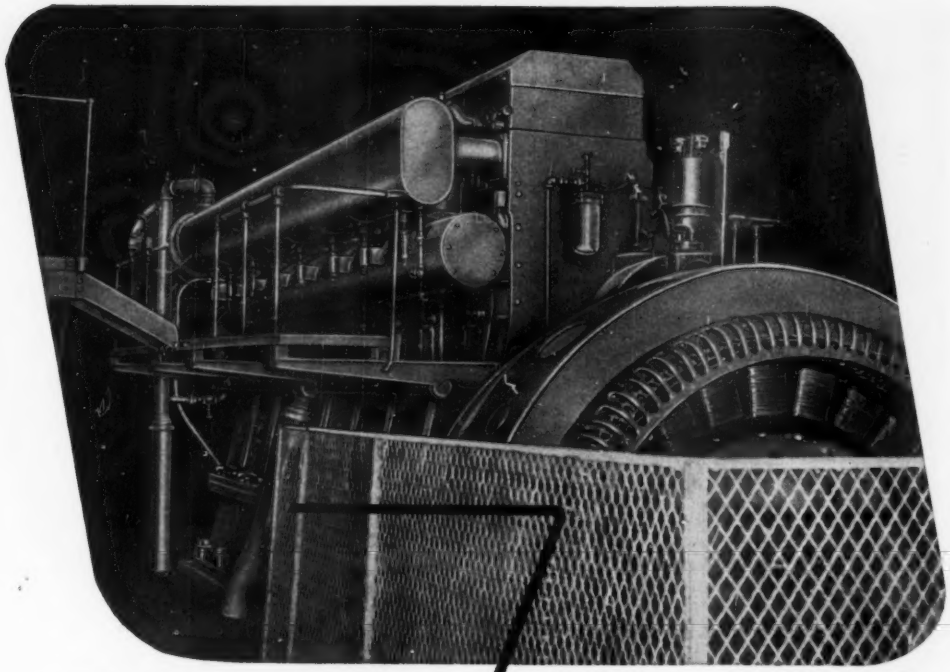


1500 H. P. Elliott Turbocharged CP Diesel installed in a midwestern utility plant.

CHICAGO PNEUMATIC heavy duty, medium and slow speed DIESEL ENGINES

Whatever may be your horsepower requirements, there is a Chicago Pneumatic Diesel engine that will meet your needs. Available in sizes ranging from 120 H.P. to 1750 H.P., these engines can be furnished either for straight Diesel or for Dual Fuel operation.

The CP engine line includes both normally aspirated and supercharged engines. All supercharged engines incorporate the thoroughly dependable Elliott Turbocharger.

Years of reliable performance and low cost power have won for Chicago Pneumatic an outstanding position in the Diesel field.

CP Diesels have proved profitable investments for public utilities, industrial, municipal, ice and water-works plants, and in mining, oil, pipeline, cotton ginning and other fields where low cost, dependable power is a vital necessity.

Write for complete information

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

"GUNITING" with *Super* ADACHROME-CAST

...SAVES OUTAGE TIME and MONEY

Use **SUPER ADACHROME-CAST** to gunite your stud tube water walls.—Fine-grained to penetrate the small apertures between studs.—packs to a dense mass when shot. One user reports **SUPER ADACHROME-CAST** lasted twice as long and took but one-third the time to apply as compared with a plastic chrome ore installation.

Excellent for coating brickwork when free of slag.

BOTFIELD

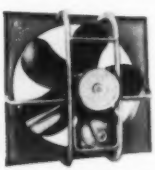
Yours, *FREE* for the asking . . . an illustrated, detailed Bulletin on *Super* ADACHROME-CAST.

REFRACTORIES CO.

784 S. Swanson St., Philadelphia 47, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto.

INCREASE production with

CHELSEA INDUSTRIAL FANS



TYPE IND EXHAUST FAN
For factories, mills, theatres, schools, hotels etc. Features belt drive with ball bearing motor. Sizes from 24" to 72".

STEP-UP OUTPUT

and quality of workmanship, reduce industrial accidents and employee fatigue with proper ventilating and cooling equipment. CHELSEA Fans remove excessive heat, fumes, dirt, dust and grit, also dead stale air. 30 models, in over 200 sizes, are available, and each fan or blower is especially engineered and tested for its recommended application. All ratings are certified by P.F.M.A. test methods to insure proper performance.

Write for Catalog No. 400 Complete data and specifications on fans and blowers for every industrial and commercial application—address Dept. V4.

TYPE BB ALL PURPOSE EXHAUST FAN

TYPE PHD PENTHOUSE UNIT

TYPE PLP POWER LINE EXHAUST FAN

TYPE PLBU POWER LINE AIR BLASTER

CHELSEA FAN & BLOWER CO., Inc.
PLAINFIELD, NEW JERSEY

FREE BOOKLET

ON ALCOA'S NEW, ALL-PURPOSE COILED TUBE

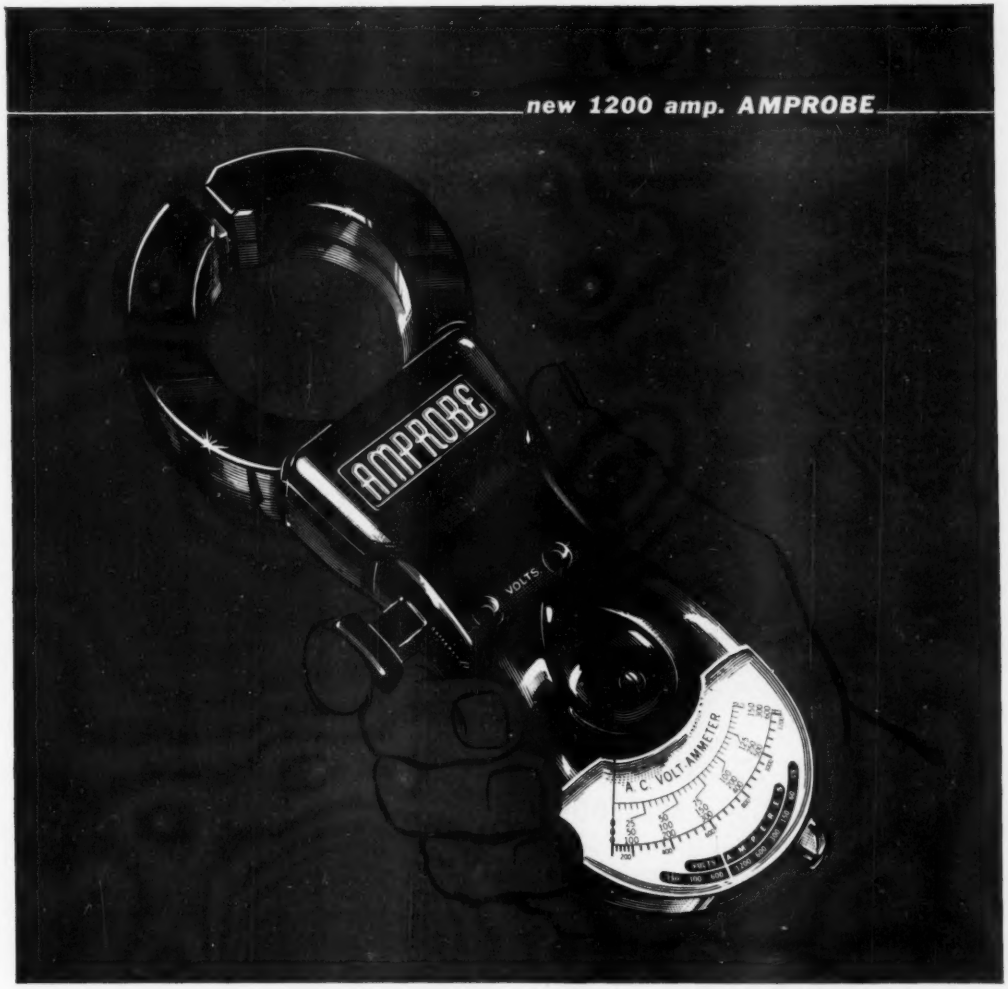
This new booklet gives complete facts about UTILITUBE—Alcoa's new, all-purpose coiled tube. Alcoa UTILITUBE is designed to handle fuel and lubricants in engines, air in instrument systems, fluids in hydraulic systems, cutting compounds in machine tools, etc.

It will save you up to 40% on tube costs. It gives you 3 times more feet per pound. It forms, flares and bends more easily than annealed copper. It will not gum, sludge or discolor the fluids it carries. Write:

ALUMINUM COMPANY OF AMERICA
836D Gulf Bldg. • Pittsburgh 19, Pennsylvania

ALCOA

new 1200 amp. AMPROBE



Take the new Amprobe "1200" into your hand. Compare it with any other high-current volt-ammeter. You'll quickly recognize the advanced engineering and design that have gone into the "1200".

ELIMINATES ERRORS: Exclusive doughnut-type transformer eliminates for all practical purposes the factor of error due to position of conductor. COVERS NINE RANGES: 0-15/60/150/300/600/1200 (yes, 1200) amps AC, 0-150/300/600 volts. SAFER: Probe jaws insulated right down to the sockets. Voltage test lead plug automatically insulates itself when removed from meter. MORE CONVENIENT: So compact, carry it in your pocket!

Only $67.50, with leather case and leads. Also Amprobe "600", up to 600 amps, $59.50. Pyramid Instrument Corp., Lynbrook, New York.
(Export Division: 458 Broadway, New York City. Cable: Morhanex).

AMPROBE®

the only pocket-size snap-around volt-ammeter

WRITE TODAY: Dept. PO1

Pyramid Instrument Corp.
Lynbrook, New York

☐ *Send Bulletin No. 128, describing new Amprobe Models "1200" and "600".*

☐ *Send 16-page manual of time-saving uses: "Servicing with the Amprobe".*

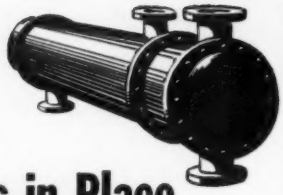
Name _____

Company _____

Address _____

City _____ Zone _____ State _____

Descale Your Heat Exchangers in Place



NO MORE dismantling and reassembling clogged heat exchangers! Now clean them in-place. Simply circulate through system specially designed Oakite scale-dissolving, sludge-removing materials. Method much faster, far safer than manual rodding, drilling, lancing.

FREE "54" Digest tells all about this—other time- and money-saving Oakite cleaning shortcuts. Write Oakite Products, Inc., 23 Rector St., New York 6, N. Y.

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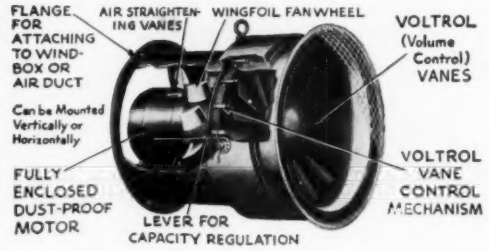
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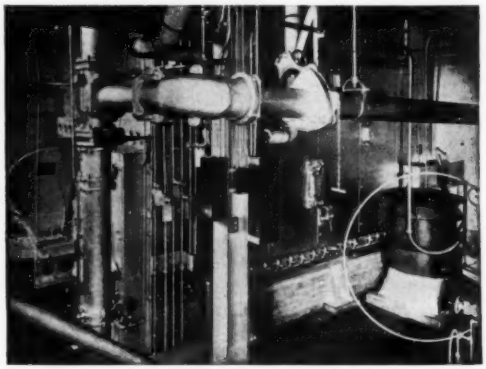

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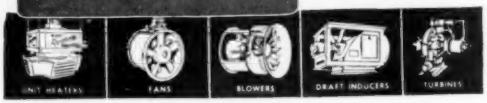

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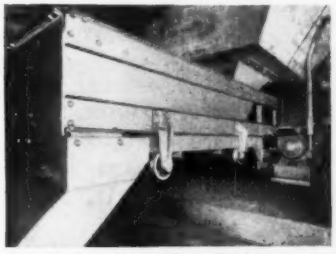

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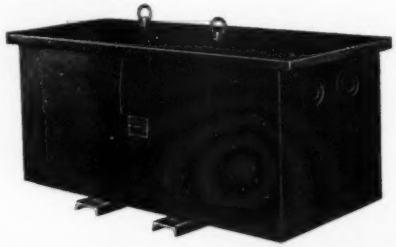

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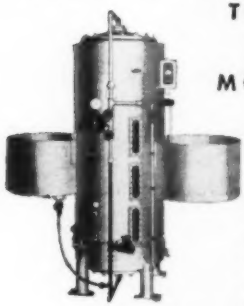

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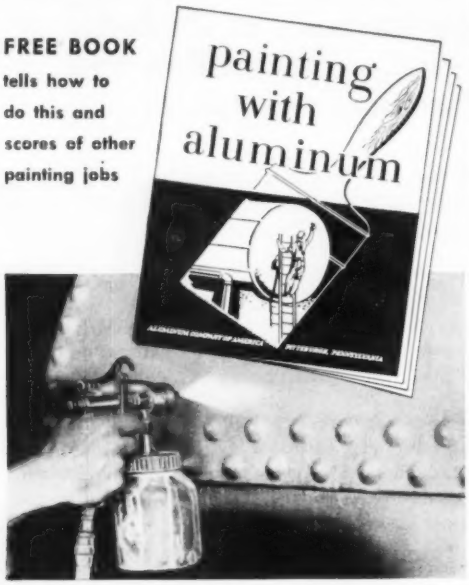

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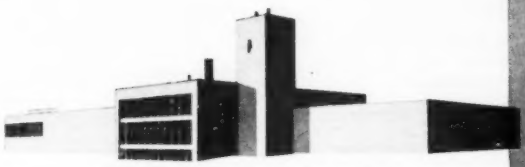

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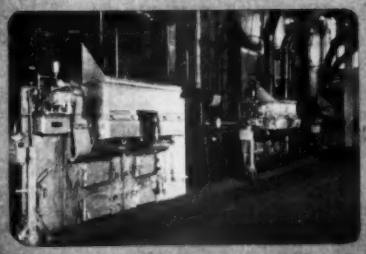

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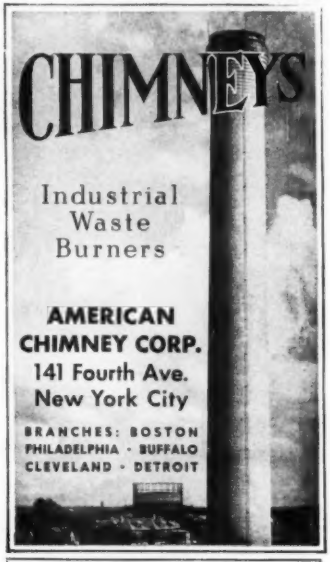

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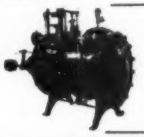
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–from "Capitalism" by David McCord Wright.

If we can only win recognition of this truth, we shall win the struggle of free men against communism. This editorial discusses some of the hurdles that must be cleared.

To win the needed recognition that "our capitalistic society... is the truly revolutionary one," we must keep pounding away both abroad and at home. That is because the communists simultaneously attack us on an international front and try to undermine us from within.

The present drive to rearm ourselves and our allies is crucial to our self-protection on the international front. We must be prepared to meet the armed force of aggressive communism with armed force if we are to secure our physical freedom.

Arms are not enough

But to re-establish parity in arms is only half of the battle. In the last analysis it is not the more important half. To be effective, our arms must be backed by loyalty of men to our ideals. So, both abroad and at home, we must win men to the faith that we do have "the truly constructive, the truly revolutionary ideal."

On the international front, the effort to win adherence to such faith in our capitalist society meets tough going. That arises from the fact that in some of the countries that are allied with us in the fight against communism, capitalist society has offered to its people no such ideal. In varying degrees "the values of opportunity, competition, democracy, productivity" – those key aspects of American capitalism – are either absent or subordinated in their economic life. Indeed, the *Wall Street Journal* recently remarked that "to the European, capitalism has become synonymous with cartels – and with the disregard cartels foster for the consumer, the worker and the over-all well-being of the nation's economy."

No Simple Solution

Nonetheless, many European labor and governmental leaders sincerely believe that cartels are essential to their economic salvation. They believe that without such restrictions in congested European markets there would be intolerable cut-throat competition and instability of employment. Thus, when we point out that the cartel capitalism so prevalent in Europe lacks the constructive qualities of competitive American capitalism, we may offend European leaders whose wholehearted cooperation we need in the fight against communism.

But, if we soft-pedal that contrast, we sacrifice the opportunity to win understanding and loyalty from millions of Europeans who have had no chance to learn that capitalism can be the constructive and liberalizing force that it is in the United States. Indeed, when many of these millions embrace socialism it is not because they love it. They are rather desperately seeking a tolerable middle course between what they consider the hateful extremes of communism and the undesirable aspects of capitalism as they understand it.

New name not the answer

We know that there is no easy way to handle the problems created by such misunderstanding of American capitalism. Neither do we share the belief that much of the difficulty would be overcome if we were to call American capitalism by some other name. By doing that, the argument runs, we shall relieve it from the unpleasant connotations that are attached to the word capitalism in some other parts of the world. But, after all, if we are to give up all the terms that have come to mean something else in other parts of the world, we must begin by ditching the term "democracy" which, in the official jargon of the Kremlin, seems to mean what we call dictatorship.

In spite of the difficulties, however, we must stick to this job of exporting the truth that our capitalist system does offer opportunity, competition and democracy. We must let the rest of the world see that it means a continuous drive for increased productivity, and the search for profits by increasing sales and consumption, not by trying to sell less for more.

Export alone not enough

The spreading of truth about American capitalism will not be effective if it is merely directed abroad. Unless it is carried on at home also, it will lack the driving faith that is essential to any convincing export of this type. Nor will export alone come to grips with the communist attack on our country from within—an attack that gets too much help from loyal Americans who short-sightedly repudiate the basic principles of our institutions in their efforts to reform some of their deficiencies. For success both at home and abroad, we must have right here at home a much more militant recognition that it is in fact our capitalist society which offers "the truly constructive, the truly revolutionary ideal."

Here at home, too, this raises difficult complications. Businessmen who are among the leaders and principal practitioners of capitalism, have generally been catalogued as conservatives. Hence, many people must stretch their imaginations a bit to see that businessmen are leaders of a development which has so greatly and so rapidly improved the lot of free men in America that it is truly revolutionary.

These difficulties of definition, however, are relatively superficial aspects of the problem of seeing our capitalist society clearly. The basic facts are that:

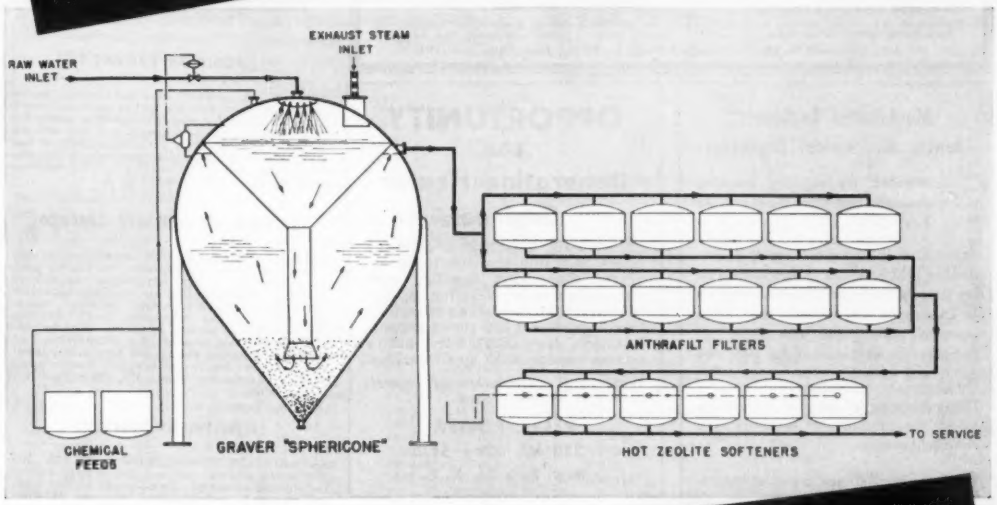
American capitalism is leading free men to an ever higher material standard of living while respecting their spiritual, social and political freedom.

Communism is leading its people back into a life of servile regimentation under dictatorship.

American capitalism advances to high ground never before attained by free men. Communism retreats to ground that men with an appetite for freedom throughout the ages have sought to escape. If we can establish this truth firmly, around the world, we shall no longer need to worry about communism. It will be hopelessly sunk.

McGraw-Hill Publishing Company, Inc.

World's Largest HOT PROCESS- Hot Zeolite Plant



When a large eastern refinery wanted the most modern, efficient and economical treating system to handle 200,000 gph of feedwater ... virtually 90 to 100% make-up ... for their 650 psig boilers, their engineers selected a GRAVER Hot Process-Hot Zeolite plant employing GRAVEX styrene zeolite.

Advantages of this type of Water Conditioning System

This Graver water treatment with hot zeolite was chosen because it offered these advantages over a hot process softener with hot phosphate after-treatment:

1. **Lower hardness in feedwater.**
2. **Lower CO_2 in steam because of lower alkalinity.**
3. **Lower chemical operating costs.**
4. **Low silica in feedwater.**
5. **A uniformly low hardness in feedwater with possible rapid variations in raw water composition.**

The plant includes a single GRAVER SPHERICONE Hot Process Sedimentation Tank ... also the largest in the world ... to handle the entire water supply. This exclusive tank design gives greatest clarity of effluent, and at the same time provides greatest economy in steel and manufacturing cost. • **Write for further information on the application of this type of GRAVER Water Conditioning System to your own feedwater needs.**

BY GRAVER

Facts about the GRAVER equipment in this plant

- One GRAVER SPHERICONE Hot Process unit 43 ft 6 in dia x 60 ft high.
- Six GRAVER Hot Zeolite Softeners, each 10 ft dia x 5 ft 6 in high.
- Twelve GRAVER Anthrafilt Filters, each 11 ft dia x 5 ft high.
- GRAVER Chemical Feeders.

●●●●●

Write for Technical Articles: "Hot Zeolite Softening" and "Factors in Hot Process Softener Design and Operation."

GRAVER

GRAVER WATER CONDITIONING CO.
Division of Graver Tank & Mfg. Co., Inc.
DEPT. P-HP, 216 WEST 14th STREET, NEW YORK 11, N.Y.

GW 488 A

SEARCHLIGHT SECTION

(Classified Advertising)

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New Ads: Address 330 W. 42nd St., New York 36, N. Y., for May issue closing April 10th.

Mechanical Engineers
Junior Mechanical Engineers

Wanted by rapidly growing Electric and Gas Company on East Coast.

Experienced Engineers and recent or prospective 1952 and 1953 graduates required for steam power plant expansion program in Engineering Department. Work offers permanent employment with ample opportunity for advancement for men with ability and initiative.

Pleasant, congenial suburban community, having the advantage of proximity to a metropolitan area.

Write, giving full particulars of education, experience and salary to:

Box P-3650, POWER
330 W. 42nd St., New York 36, N. Y.

When required, personal interviews will be arranged for evenings or Saturdays.

WANTED
MECHANICAL ENGINEER

Experienced mechanical engineer with steam background capable of engineering, selecting equipment and designing steam plant, auxiliaries and distribution system. Electrical experience also desirable. Location, south. Write complete qualifications in first letter, including references and salary desired. Details confidential.

P-3646, POWER
330 W. 42nd St., New York 36, N. Y.

WANTED: Experienced Power Station Engineer.
POSITION: Assistant to Manager of Power Production with administrative responsibility of operating central stations totaling approximately 800,000 kw.
LOCATION: Pennsylvania.
ADVANCEMENT: Excellent for growth on job and promotion in near future.
EXPERIENCE: 10 years minimum, with at least 5 years in operation, maintenance or efficiency work in large modern steam-electric central station. Construction and design experience will be considered.
EDUCATION: B.S. degree in Mechanical (preferred) or Electrical Engineering from an accredited engineering college.
AGE: 30-45.
Salary commensurate with qualifications.
All applications will be acknowledged.
Please send personal record to
P-2126, POWER
330 W. 42 St., New York 36, N. Y.

OPPORTUNITY
FOR
Deaerating Heater Engineer

Large well established company offers desirable position to an engineer thoroughly familiar with the design and operation of deaerating heaters to take charge of this department of the company. Location, New York City. Salary commensurate with qualifications.

Write full particulars of experience and personal data.

P3636, POWER
330 W. 42nd St.
New York 36, N. Y.

ENGINEERING DRAFTSMAN AND DESIGNERS

Experienced in Plant Layout, Process Piping, Power and Lighting Layouts, Structural Steel and Reinforced Concrete Design.

Submit Complete Resume—Education, Experience and salary expected.

The Solvay Process Division

ALLIED CHEMICAL & DYE CORP.
SYRACUSE 1, N. Y.

WANTED
MECHANICAL ENGINEER

Established consulting firm, New York area, desires Mechanical Engineer, capable supervising starting, testing, operating and correcting troubles of steam-electric station equipment. Plant betterment work involving considerable travelling. Technical education, and plant operating or betterment experience required. State education, experience and salary desired.

BOX P-3637, POWER
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REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

DESIGNERS, LAYOUT Men and General Draftsmen on steam turbines and related equipment. We are looking for men who prefer a steady job in a thriving essential industry and who will enjoy living in a pleasant rural community of less than 10,000 population. Excellent schools. Healthful climate and living conditions. Applications confidential. P-3215, Power.

SELLING OPPORTUNTY OFFERED

SALES ENGINEERS, with experience in the sale of mechanical equipment, wanted for positions involving general application and sale of heating, ventilating, and air handling apparatus for commercial and industrial buildings, industrial processes, and mechanical draft. Position are available at various locations. Personal interviews will be granted only after receipt of written application giving full details of experience. Address: Sturtevant Division, Westinghouse Electric Corporation, Dept. AH, Hyde Park 36, Boston, Mass.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500 to $35,000. We offer the original personal employment service (established 42 years). Procedure of highest ethical standards individualized to your personal requirements. Identity covered; present position protected. Ask for particulars. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONAL $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

POSITIONS WANTED

1939 EE GRADUATE, age 35, now assistant superintendent of 50,000 Kw steam electric station. Entire time since graduation spent in some phase of steam electric station operation, except time spent in military service during WW II. Familiar with oil, natural gas and coal fired stations up to 900 pounds steam pressure. Considerable experience training operators in all phases of steam electric station operation. Present position at a station employing 100 men. Seeking a responsible position in this field. Will consider electric utility or industrial opportunities. PW-3707, Power.

WATCH ENGINEER—Ass't Power Supvr. Young married man. State of N. J. Gold Seal stationary license. Sound technical and practical background. Thorough experience modern power dept. Water-treatment, high pressure boilers, condensing and non-condensing turbo-generators. PW-3377, Power.

MISCELLANEOUS

Is Your Mind New Enough

to make what is probably the most significant decision of your life? If you know it is. Then you are, in complete challenge, expressly invited to link your future with that of a group planning to move to central Chile summer 1952. These families, men and women, plan to bargain as a group for home sites and live together as neighbors to establish a Chilean corporation to develop some essential industries and begin rather significant possibilities. For application questionnaire, Write G. D. Krouse, 1535 Whitney Street, Augusta, Georgia.

BUY or RENT From L. J. LAND for

- Dependable Equipment
- Reliable Rebuilding
- 1 YEAR GUARANTEE
- REAL VALUES

1 to 50 HP
NEW and REBUILT
TEFC—EX. PR.—Drip proof and Splash proof—Geared Head
IN STOCK

SQUIRREL CAGE MOTORS
3 phase

H.P.	Make	Type	Speed
250	G.E.	KT 559	1750
200	Wagner	RP226F	1800
200	Al.Ch. (2)	BB	880
200	G.E.	KF-6335	880
150	West.	CS	1150
150	West.	CS	580
125	Al. Ch. (5)	AR	1750
100	West.	TEFC	3600
100	Al. Ch.	AR	1150
100	West.	CS	870
100	G.E.	IE-K	1800
100	G.E.	K-544	1175
75	West. (2)	CS-654C	1750
75	G.E. (2)	KT347	1150
75	G.E.	IK	900
75	G.E.	KT-352	865
75	West.	CS	720
60	Howell	SCR	1800
60	West. (2)	CS-607	880
60	Rel.	AA	875
60	G.E.	KT-346	865
60	G.E.	TEFC(GH)	427
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	G.E. (2)	KT	1740
50	G.E.	XP	1750
50	G.E.	KF-445	1170
50	West (3)	CS	870
50	G.E. (2)	IK	870

SLIPRING MOTORS
3 Phase

H.P.	Make	Type	Speed
600	Cr. Wh.	131AQ	507
500	G.E. (2)	IM	450
500	Ideal		1150
400	West.	CW	450
400	G.E.	IM	870
250	G.E.	IM	435
225	Wagner	25 cy.	710
200	G.E.	MT559Y	1170
150	Wagner	31VRN	900
150	Burke		720
125	West.	CW	1750
125	Burke		600
100	G.E.	MT347	1150
100	G.E.	IM	690
75	Lincoln	IXM	1750
75	West.	CW	1150
75	West.	CW	720
75	G.E.	IM	690
60	G.E.	MT533	1750
60	West.	CW116	290
50	G.E.	MT-536	1150
50	Wagner		1150
50	L.A.	OGH	870
50	Cr. Wh.		900
50	G.E.	MT546	720
50	G.E.	IM	490

SYNCHRONOUS MOTORS

H.P.	Make	Type	Speed
475	West.		720
300	G.E.	ATI	900
200	West. (3)		900
180	G.E.	ATI	900
150	G.E.	TS	900
150	G.E.	TS	720
150	G.E.	ATI	900
100	G.E.	ATI	1200
75	G.E.	TS	900
55	El.Machry.	BRKT	1200

230 V.D.C. MOTORS

H.P.	Make	Type	Speed
150	G.E.	L.C.	1750
100	Al.Ch.		1150
90/45	G.E.	RF-17	950/475
75	Cr.-Wh.	53H	850
75	G.E.	RC36	800
75	West.	SK-180	475
75	Cr. Wh.	CMC	375/950
60	West.	SK-160	680
60	West.	SK	250/1000
50	G.E.	CD	3600
50	West.	SK-160	845
50	G.E.	RF-17	250/1000
45/90	G.E.	RF-17	475/1950
40	West.	SK-103	1750
40	G.E.	RC-31	1700
40	G.E.	CD-1441	400/1500
40	Rel.	461T	400/1200
35	West.	SK	250/1000
35	West.	SK-120	1150
35	G.E.	RLC	440/880
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West.	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	Rel.	92T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	600
25	G.E.	RF-14	800/1200
25	West.	SK113	850

115 V.D.C. MOTORS

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CCM	900
40	G.E.	DLC	1150
40	G.E.	RC	1050
40	G.E.	CD-113	850
30	Eck.		950
25	G.E. (2)	CD	1800
25	G.E.	CD93	1150
25	Cr.Wh.	CCM	750
25	West.	SA	600/1200
20	G.E.	CD85	1150
15	E.D.	7½S	650/1230
15	Cr.Wh.	CM	650
15	Cr.Wh.		1800
15	G.E.	RC	1200
10	Al.Ch.		900
10	E.D.	7½S	425/1700

550 V.D.C. MOTORS

HP	Make	Type	Speed
765	G.E. (3)	MPC	1045/1350

AC GENERATORS

KW	Make	Speed
180	G.E. ATB	900
100	G.E. ATB	360
40	G.E. ASI	1200
15	G.E. ASI	1200

AC GENERATORS
Driven by DC Motors

KVA	Make	D.C. Input	A.C. Output
62½	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	Ely. Machry.	230	440
18	G.E. (3)	230	120/240
10	Burke	115	120
7½	Hertner	115	440
6¼	G.E.	230	240
5	El. Spec.	115	110
1¼	Al. Ch.	230	110

600 V.D.C. GENERATORS

KW	Make	Speed
400	G.E. (4)	1200
225	G.E.	1200
30	Burke	1750
20	Reliance	1150

GENERATORS
250 V.D.C. Motor Driven

KW	Make	Speed
1000	G.E.	514
500	G.E.	900
400	Cr.-Wh.	1200
300	Elliott	1200
250	Cr.-Wh.	1200
250	G.E.	1150
200	G.E.	1200
200	Al. Ch.	900
150	West.	900
125 (2)	G.E.	1200
100	West.	1200
100	Delco	1200
100	G.E.	700
75 (2)	Cr.-Wh.	1200
75	G.E.	1200
40	Rel.	1750
42	ABC (2)	1200
30	G.E.	1200
25	G.E.	1200

125 V.D.C. Motor Driven

KW	Make	Speed
150	West. (2)	1200
100	West. (2)	900
100	G.E.	1200
100	El. Machry.	1200
100	West.	1200
75	G.E.	1150
50	West. (2)	1150
30	G.E.	1150
30	L.A.	1450
25	El. Machry.	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
10,000	HVW	6/12
10,000	North.	2½/10
4,000	HVW	6/12
5,000	HVW	6/12
2,500	Chandeysson	6/12
125	Hobart	7½
500	Chandeysson	12
1,000	West. SK	24
1,500	Century	24
2,000	G.E.	24V
100	Hertner	28
150	G.E.	30
200	West.	30
500	West.	32
1,000	G.E.	33
150	Watton	40
1,000	Chandeysson	40
200	G.E.	42
225	West.	50
1,500	G.E.	50
1,500	Century	60
1,500	G.E.	60
1,000	G.E.	75

FREQUENCY CHANGERS AND GENERATORS

Size	Make	Output Frequency
150 KW	G.E.	150 cy.
154 KVA	G.E.	150 cy.
10 KW	G.E.	200/700 cy.
7½ KW	G.E.	400 cy.
5 KVA	West.	400 cy.

ELECTRIC HOISTS

1000# Y & T—D.C.
1000# Thor—Air.
1000# Y & T—A.C.
1000# Shepard—A.C.
2000# R & M—D.C. (3)
2000# C & M—D.C.

GUARANTEE YOUR INVESTMENTS!

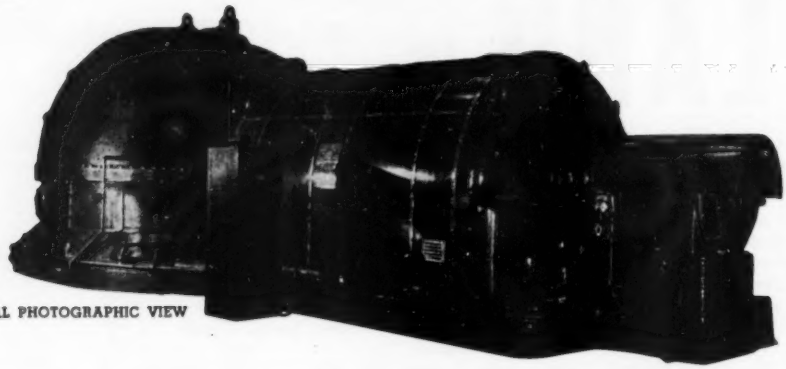
- LAND gives 1 year guarantee.
- All equipment listed in stock.
- You can see your machines run and tested under power before shipment.
- Complete shop facilities with thoroughly trained & experienced mechanics (many have been with us over 25 years).
- Responsible Organization —41 years' experience.

Partial List ONLY

EST. 1910 — L. J. LAND INC. — 42nd YEAR

156 GRAND STREET — Phone CAnal 6-6976 — NEW YORK 13, N.Y.

25,000 KVA—20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° T.T. complete with direct connected shaft exciter, switchboard, a 30,000 square foot Westinghouse surface condenser and condensing accessories, including 2—150,000 pounds steam per hour B&W sectional header cross drum boilers, 250# pres., 550° T.T. equipped with Taylor retort stokers.



ACTUAL PHOTOGRAPHIC VIEW

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

Condensing—3 phase, 60 cycle

6250 KVA G.E., 5-stage, 2300/4160 volts, 200# P.S.I., 600° TT.
4000 KVA Allis, 2300 volts, 150-200 PSI.
3750 KVA Westghse. 2300 volt, 200 PSI.
2500 KVA G.E. Type ATB, Form HT, 2300/480 volts, 3600 RPM, 2-bearing alternating current generator LESS TURBINE.
2500 KVA Westghse. 2300 volt, 250 PSI.
1563 KVA Allis, 600 volts, 200 PSI.
1250 KVA G.E. AUTOMATIC EXTRACTION BLEEDER 2300 volts, 250 PSI.
937 KVA Allis, 480 volts, 250 PSI.
780 KVA Allis, 480 volts, 150 PSI.
625 KVA G.E. 480 volts, 150 PSI.

Non-condensing—3 phase, 60 cycle

1563 KVA G.E. 600 volt, 250 PSI, 20# gauge back.
940 KVA Allis 2300/480 volts, 125-150 PSI 12# back.
625 KVA G.E. 480 volts, 125-150 PSI, 20# back.
375 KVA Westghse-Moore 480 volts, 250 PSI 5-10# back.
250 KVA Allis 480 volts 125 P.S.I.
125 KVA G.E., 2300 volts, 150-200 PSI.
125 KVA Westghse. 2400 volts, 150-250 PSI 10# back.

Direct Current

500 KW G.E., 250 volt, 200 P.S.I., 25# gauge back non-condensing.
300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing.
100 KW (2) G.E., 125 volts, 200-275 PSI.
75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.
60 KW (2) Elliott, 125 volt, 200-250 P.S.I. non-condensing.

MOTOR GENERATOR SETS

100 KVA Westghse. 60 cycle, 2400 volts, alternator connected 135 HP, 250 volt direct current motor.
62½ KVA G.E., 60 cycle, 2300 volt alternator to 75 HP, 125 volt DC motor.
50 KW G.E. 125 volt direct current 1200 RPM to a 3 phase, 60 cycle, 220 volt syn. motor.
10 KW G.E., 125 volt direct current to a 3 phase, 60 cycle, 220 volt motor.

April BARGAINS SPECIALLY PRICED

800 KW, 60 cycle, 2300 volt, 600 RPM Westghse. alternator with complete base for direct connection to Diesel engine.
2—225 HP, 400 RPM Buckeye Diesel engines each connected 1875 KVA, 60 cycle 240 volt Electric Machinery generators.
547 HP, 250# pres. and three 400 HP, 225# pres. B&W water tube boilers.
8000 sq. ft. Wheeler, 4400 sq ft. Worthington, 2000 sq. ft. Worthington and one 1500 sq. ft. Westinghouse surface condensers.
4900 GPM and 3500 GPM Allis 2-stage pumps, 130 ft. hd. each direct connected 400-325 HP Allis 3 phase, 60 cycle, 2300 volt motor.
2—1000 GPM, 1270 foot head, 4-stage Morris pumps each connected 417 HP, 390# P.S.I., G.E. turbine.
25 HP G.E. 60 cycle, 220 volt, 1170 RPM T.E.F.C. motor.

SYNCHRONOUS MOTORS

3 phase, 60 cycle

5000 KVA Westinghouse, 4000 volt, 720 RPM Electrical Syn. (condenser).
900 HP Allis, 2200 volts, 150 RPM.

UNAFLOW GENERATOR UNITS

625 KVA G.E. 240 volt generator connected 29"x36" Skinner horizontal engine, 150 PSI complete.
500 KVA G.E. 240 volt generator connected Skinner Vertical engine 150-175 PSI complete.
375 KVA G.E., 2300/440 volts generator connected 23"x24" Skinner Horizontal engine, 125-150 PSI.
175 KVA Westghse., 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

Direct Current

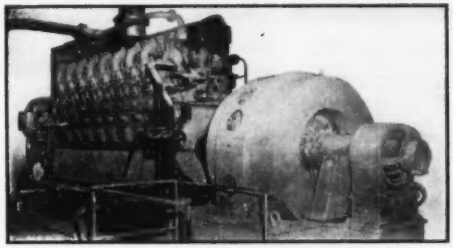
400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.
250 KW Crocker Wheeler 125 volt generator direct connected Ames Vertical non-condensing engine 150#.
20 KW Allis 125 volt generator connected Hill vertical Diesel engine.

UMC UTILITIES MACHINERY CORP.
1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

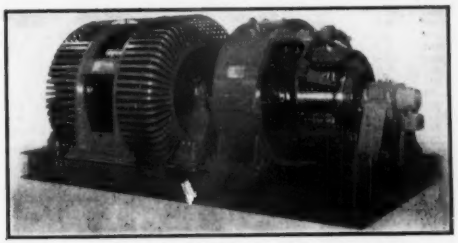
"THE O'BRIEN STORY"

AVAILABILITY . . . SPEED . . . SERVICE . . . ECONOMY . . . these are the facets for which the O'Brien name is famous in the Machinery Industry. These are the factors behind which The O'Brien Machinery Company has built their business and reputation over the past 37 years, and these are the reasons, so vital to National Production today, that O'Brien is called upon to supply the Nation's leading Industrial firms with Power Plant and Metal Working Machinery of all types. National production and Defense requirements in today's world demand speed and that's why one source of supply for your Industrial Machinery is of prime importance to you. Splitting the responsibility for furnishing plant equipment wastes time, trouble and transportation. Why do it when time is so precious, dependability and delivery so vital to your production. From one source you can secure all your requirements, not only for Power Plant equipment, but also for Metal Working Machinery of all types. Place your complete order with . . . *O'BRIEN* . . . your responsible source of supply . . . and be absolutely assured of . . . Availability . . . Speed . . . Service and Economy.

Read more about "The O'Brien Story" in the next issue of Power



1250 KVA GM DIESEL GENERATOR SET



500 KW WEST. MOTOR GENERATOR SET

MOTOR GENERATOR SETS

1—1500 KW GE MPC 300 V 5000 Amp.—2150 HP ATI-Syn Motor, 3/60/4000 Volt. Available immediately.
1—1000 K.W. West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels.
1—660 KW G.E. MPC—2400 amp. 230 volt 514 RPM with 1050 H.P. G.E.—ATI Syn. Motor .8 P.F. 2 ph., 60 cy., 2300 V. A.C. & D.C. Panels. Can furnish 3 ph. 550 V. or 2300 V.
1—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/6600/13200 volt. Serial #813047 (year 1935) See actual photo above.
1—500 K.W. Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/6/2300 V. A.C. & D.C. Panels.
1—400 KW West. 500 Volt D.C. Any A.C. Voltage with 500 HP West. 350 RPM, 500 Volt Motor for complete drive.
1—360 KW GE CY 125, 180 V., Sep. Exc., 1200 RPM, 500 HP Syn. Mtr., 3/60/2300, 1942.
1—300 K.W. West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
1—300 K.W. Elliott 250 Volt 1200 RPM with 500 H.P. Syn. Motor 3/60/2300/1200 RPM —Automatic Controller & D.C. Panel.
2—150 K.W. G.E. Type MFC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels.
1—100 K.W. Al. Ch., 250 V. 1200 RPM 150 H.P. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 K.W. G.E.—C.D.—125 Volt D.C. 150 H.P. GE Syn. Mtr., 3/60/220/440/1200 RPM.
1—75 K.W. Burke 250 V., 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
2—50 KW GE 500 Volt DC, 75 HP, 3/60/440/1200 RPM.
Smaller Sizes and Types–Advise Requirements

CENTRIFUGAL PUMP

Qu.	GPM	TNH	Descr.	Size	HP	Speed
1	8,000	110′	Worthington	14″	300	1200
1	6,000	110′	Ingersoll-Rand	12″	200	1200
1	4,000	110′	Ingersoll-Rand	12″	200	1200
1	3,500	47′	Southwalk	12″	100	870

CENTRIFUGAL PUMP (Con't)

2	1,700	95′	De Laval	16″	60	1750
1	1,500	231′	Allis-Chalmers	8″	150	1750
1	1,200	40′	Worthington	6″	15	1750

DIESEL & GASOLINE GENERATOR SETS

2—1250 K.V.A. GM 16 Cyl. 3/60/2300 New 1946 Comp. Plant. (See Photo Above)
1—937 K.V.A. GM 12 Cyl. New Engine. Rebuilt Gen. 3/60/480 or 2300.
1—625 K.V.A. Baldwin Series 600—New 1948 —1500 hours. 3/60/2300/514 RPM.
2—438 K.V.A. GM—West. 3/60/2200 360 RPM —New 1937. Complete Plant.
2—375 K.V.A. GM 8-268A, 3/60/480/1200 RPM.
1—300 K.W. GM New 8-268A, 230 DC.
1—250 K.V.A. GM Twin 6-71, 3/60/220/440.
1—125 K.V.A. GM New Twin 4-71, 3/60/220.
1—125 K.V.A. Hercules. 3/60/220/440/1500 Hrs
1—62.5 K.V.A. Cummins 6 Cyl. 3/60/220/440.
1—56 K.V.A. Climax Gasoline. 3/60/220/1200.
2—45 K.V.A. Chry. New 6 Cyl. 3/60/220/440.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
3	500	West.	CS	6600	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
1	315	G.E.	Syn.	2200	720
1	200	West.	Syn.	2300	1200
1	150	Ideal	Syn.	220	1200
1	125	West.	Syn. (3 brg.)	550	600
1	125	Cent.	SC	440	1800
2	100	G.E.	Syn.	440	300
1	75	West.	CW	440	1200
1	50	West.	CS	440	3600

TURBO GENERATORS

1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.
2—375 KVA West. Non-Cond. 3/60/440 125 psi 5 B.P. New 1938

TURBO GENERATORS (Con't)

1—300 KW West. 3 wire 125/250 Volt D.C., Non-Cond. Turbo Unit 125 PSI, 5 lbs. B.P. New 1938
1—75 KW G.E. Non-Cond. D.C. 125 volt.
1—35 KW G.E. Non-Cond. D.C. 125 volt.

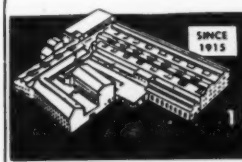
AIR COMPRESSORS

1—12,000 CFM I.R. Turbo 3.25 Lb., direct 250 H.P., 440/3/60/3600.
1—5600 CFM I.R. PRE-2, 42/25½x30, 100 lb. direct 930 HP Syn. 1 P.F. 2300/60/3.
1—4690 CFM I.R. PRE-2 48/24x27 100 lb. direct 804 HP Syn. .8 PF 2300/60/3.
1—3000 CFM GE Turbo 5 lb. direct 90 HP 440/3/60/3600.
2—1400 CFM Sullivan WJ 3 Angle Cpd. 100 psi 22/13x16 belt.
2—1200 CFM I.R. 22/13x16 100 psi belt.
1—900 CFM CP 100 lb. 9CP Portable Diesel Compressor, Pneu. tires.
1—734 CFM Sullivan W-13 13/13x8 60 lb. belt.
1—528 CFM CP NSB 14x12 100 lb.
1—371 CFM Schramm 7¼/5x4 100 lb.
1—368 CFM I.R. ER-1 12x10 100 psi.
1—350 CFM I.R. type 40 7/4½x8 air cooled 125 lb. direct 75 HP 220/440/60/3 870.
1—396 CFM Sullivan type WL-60 100 psi.
1—215 CFM Penna. 3A 10x8 50 lb.
1—173 CFM CP NSB 9x8 100 lb.
1—173 CFM Penna. 3A 9x8 100 lb.
1—122 CFM Worthington 7x7 Horiz. 100 lb.
2—80 CFM CP 6x7 TB 150 lb.
1—40 CFM I.R. Type 30 80 lb. Tank mtd. 7½ HP
3—21 CFM Curtis CJ-1000, 3 stage 850 lb.
5—16.86 I.R. Type 30, 3½/2x5 400 lb.
100—10 CFM I.R. Type N 26 lb. or 25" Hg. Vac.

BOILERS (ASME)

2—106 H.P., Keeler, Self-contained, 125#
1—240 H.P., Keeler, Horizontal, Long-Drum, Water Tube, 200#
2—250 H.P., Bigelow, Self-contained, 125#
2—360 H.P., Springfield, Cr. Drum, Str. Tube, Sect. Hdr., Water wall 250#
1—390 H.P., Springfield, Cr. Drum, Str. Tube, Sect. Hdr. Water wall, 300#

"Everything from a Pulley to a Powerhouse"



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PHILADELPHIA'S LEADING MACHINERY DEALERS & EXPORTERS

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RE-NU-BILT BELYEA MOTORS

THE TRADE MARK WITH A MEANING SUCCESSFUL OPERATION GUARANTEED 44th YEAR OF SERVICE—MEMBER OF A.R.A.*

MOTOR GENERATOR SET

3 ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
2	2000*	G.E.	560	600	6600/11000
1	1500	G.E.	720	600	4800/13200
1	1500	Whse.	600	600	2300/4600
1	1500	G.E.	360	275	2200/4100
	1500	G.E.	600	600	2300/4150
2	1000	Whse.	900	600	2300/4150
1	1000	G.E.	720	600	2300/4800
1	1000	G.E.	900	260	4800
1	1000(3U)	G.E.	900	250	2400/4800
1	500	Whse.	900	270	6600/13200
1	500	Whse.	1200	125/250	2300
1	500	G.E.	720	125	2300/4000
1	400	G.E.	720	250	440/2300
1	400	Whse.	1200	250	2300
1	350	G.E.	900	125	2300/4150
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	130	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	600	125/250	2300
1	125	G.E.	1200	125	440
1	100	G.E.	1170	125	220
1	100	Dalco	1200	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
1	70	G.E.	1200	70	220/440

*25 Cycle

ROTARY CONVERTERS

60 Cycles

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G.E.	514	600	13800
1	1000	Whse.	900	600	11000

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	6000	Al. Ch.	Condensing 200/250 ISP 2300/3/60-Exc. & Surface Cond.
1	2500	G.E.	Auto. Ext. Cond. 900 lbs.-800* F.T.T. 175/200 Auto. Ext. 2300/3/60 Exciter & Surface Cond.
2	1000	G.E.	Non-condensing. 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 440/3/60.
1	750	G.E.	Condensing 425#-725°TT ISP-440 V. 3 ph. 60 cy New—1944
1	500	Moore	Non-condensing — 150/200 lbs. ISP 5/25 lbs. G.B.P.—3/60/480 volts direct connected exciter
3	500	G.E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60.
1	400	Whse.	Non-condensing 125/150# ISP 5/10# G.B.P. 240/480v. 3 ph. 60 cy.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V. D.C.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240 V. 3 ph. 60 cy.

400 KW MADE UP MG SET
CAN MAKE UP SIMILAR SET

D. C. MOTORS

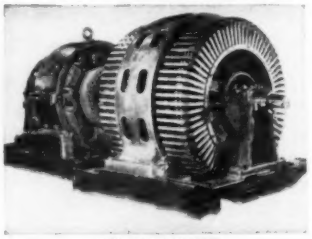
Qu.	HP	Make	Type	Volts	Speed
1—	2200	G.E.	MCF	600	360/500
1—	1750	West.		600	525/720
1—	1500	Whse.		525	800
1—	940	Whse.	QM-B. Brg.	250	140/170
1—	800/1000	Whse.		450	600/720
1—	600	Al. Ch.	MILL	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	300/400	G.E.	DYNA	250	1325/2500
1—	350	Cr. Wh.	CCM-151H	230	1100
1—	335	Whse.	MG	250	300/900
1—	200/300	G.E.	MPC	230	350/920
1—	250	G.E.	MPC	230	400/500
1—	150	G.E.		600	250/750
10—	150	Cr. Wh.	83H	230	890
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	380/950
1—	50/120	G.E.	MPC	230	250/1000
2—	100	Whse.	SK-181	230	450/1000
4—	75	G.E.	TLC-50	250	850/2500

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—3000		G.E.	25/60	4000/2300x2300/4000
1—1000		G.E.	25/58	4400/2300
1—	500	A.C.	25/60	11000/2300Y

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed
1	5000	Whse.	2400/4800	600



500 KW MG SET
IN STOCK

TRANSFORMERS

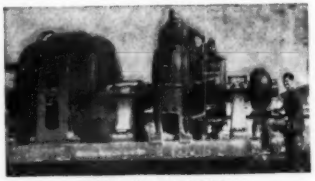
60 Cycles

Qu.	KVA	Make	Type	Ph.	Voltages
2	1250	G.E.	HT	3	13200x440/2200
1	1200	A.B.B.	OISC	3	13800/6900x480
3	1000	G.E.	H	1	2200x480
3	1000	Pitts.	OISC	1	22000x13200/2200
3	1250	G.E.	H	1	6600x550
1	1150	A.C.	OISC	3	13200x2300/480
1	900	G.E.	HTH	3	2400x240/480
3	500	Al. Ch.	OISC	1	11800x6600
1	500	Whse.	OISC	1	34650x432
1	500	Whse.	OISC	3	13400x216
3	333	Whse.	OISC	1	44000/22000x2300
3	300	Whse.	OISC	1	44000/22000x2300
9	300	G.E.	HT	3	2400x240/480
3	150	Whse.	OISC	1	34500x230/460
3	100	G.E.	OISC	1	2400x120/240

RECTIFIERS

Qu.	KW	Make	Type	Volts	Speed
1—	750	G.E.	BHW	575	2200
1—1000		A.C.	B-612	625	13500
1—1000*		A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.



2000 KW—MG SET
IN STOCK

A. C. MOTORS

3 ph. 60 Cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
3—2100	G.E.	ATI	2300	360
2—2000	Whse.		2300	120
2—1750	G.E.	ATI	2300	3600
2— 900	Al. Ch.	(New)	2200	180
3— 725	G.E.	ATI	2200/12000	600
1— 500	G.E.	TS 7657	2400/4800	600
1— 450	Whse.	Eng.	2200	128.5
1— 450	Whse.		2300	450
2— 350	G.E.	TS	2200	150
1— 300	Whse.		2300	720
1— 100	Whse.		550	600
1— 100	F.M.		220	1200
1— 100	E.M.		440	600
1— 85	G.E.	TS	440	1800

SLIP RING

1—2500	G.E.	MT	6600	257
1— 500	Whse.	CW	550	250
2— 500	G.E. unused	M-574Y	2200	900
1— 500	G.E.	IP	550	585
1— 500	G.E.	IM	440	900
1— 350	G.E.	MT442-Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	505
1— 300	Al. Ch.		2200	385
4— 300	G.E.	ITC-5017	550	585
1— 300	Al. Chal.	ANY	2200	720
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
1— 200	G.E.	MTP	440	1170
3— 200	G.E.	IM-17	440	880
1— 150	new Whse.	CW	2300	450
4— 125	G.E.	MT-566Y	440/2200	435
1— 100	G.E.	IM-16	2200	435
2— 100	G.E.	IM	440	600
3— 100	Al. Ch.	ANY	440	885
1— 100	G.E.	MT558	2200	900
1— 75	Whse.	CW-761	2200	1725

SQUIRREL CAGE

2— 650	G.E.	FT559BY	440	3750
2— 450	Whse.	CS	2300/4150	354
1— 300	G.E.	KT-574Y	2300	595
1— 300	G.E.	IK-17	440	580
1— 200	G.E.	KT557	440	1800
1— 200	G.E.	IK	440	895
1— 150	Wstghse.	CS856S	440	880
1— 125	Whse.	MS	440	485
1— 125	G.E.	KF-TEFC	440	3585
2— 125	Al. Ch.	ARW	2200	1750
1— 100	G.E.	IK-Vert.	2300	450
1— 100	G.E.	KT-513	220/440	1750

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. . . YOU CAN FIND EQUIPMENT YOU NEED —

LARGE STOCKS - ON - HAND

Our modern plant houses one of the nation's largest stocks of motors and equipment. Here you will find row upon row of motors, rebuilt and ready for use to meet your requirements. From this complete stock you can be sure that you will find what you need and that it is quality equipment fully guaranteed.

GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A PARTIAL LISTING OF OUR HALF-MILLION DOLLAR STOCK

SQUIRREL CAGE
MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
1000	*G.E. (New)	K6347S	1800
750	*G.E.	KT	720
500	*G.E.	PEQ	1800
500	*Fr.-Morse	HS	1200
450	*G.E.	KF-567S	1200
400	*Cont. (New)	NZ	1300
400	*G.E.	IK	514
350	*Cr-Wh.	SC	3600
300	*Westgh.	CS	3600
300	West.	CS	514
300	G.E.	IE-K	1200
300	Al.Ch.	AR	900
250	*L.-Allis	OGX-148S	720
250	Al.Ch.	630DSWW	1200
250	G.E.	IK	600
200	*G.E.	IK-13B	1200
200	G.E.	IK-17	600
150	G.E.	KT-546	1800
150	G.E.	IEK	1800
150	*Al.Ch.	AN	1800
150	*G.E.	IK	600
125	*A.C.	AR-226	1800
100	*G.E.	PT542Z	1800
100	G.E.	FTRP	1800
100	*Westgh.	CS	1800
100	U.S. (Vert.)	CFU	1300
100	Al.Ch. (new)	AW	1200
100	G.E.	IK15A	1200
100	*West.	CS	1200
75	West.	CS643C	1800
75	G.E.	KT-346	1200
75	Triumph	TR16	514
75	G.E.	IK	600
75	G.E.	IE	514
75	Al.Ch.	AN	1800
60	*Westgh.	CS504	1800
60	A.C. (New)	APZ445S	1800
50	G.E.	KT527	1800
50	U.S. (Vert.)	SCV937	1800

Hundreds of Smaller Motors

SLIP RING
MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
1200	*Cr.-Wh.		240
500	Westgh.	CW	359
400	A.C.	3 Brg.	450
400	*G.E.	MT-412	450
300	*G.E.	IM-15	1800
300	*G.E.	MT-410	450
250	Westgh.	HF15H	600
200	Westgh.	CW	600
200	G.E.	IM	1800
150	Westgh.	CW772C	1200
150	*G.E.	IM-16	600
125	*G.E.	MT-549	1800
125	G.E.	IM17A	600
100	A.C.	ANY	900
100	G.E.	IM	450
75	G.E.	MT547	1200
75	G.E.	MT356	900
75	G.E.	IM	720
75	Star	OSOO	900
60	Westgh.	CW762C	900
50	G.E.	IM11A	1800
50	A.C.	ARY	1800
50	Westgh.	CW636A	1200
50	G.E.	MT596	720
50	G.E.	IM	600
50	G.E.	IM14	425
40	G.E.	MT536	1200
40	Westgh.	CW642C	1200

D. C. MOTORS
Mill Type—Pedestal Bearing—Reversing

H.P.	Make	Volts	Speed
3000	Westgh. (Tandem)	525	600
1750	Westgh.	600	550
1500	Westgh.	525	600
1200	Westgh.	525	600
1000	Westgh.	450	600

D. C. MOTORS
230 Volts — Constant Speed

H.P.	Make	Type	Speed
375	Westgh.	Ped	650
200	Westgh.	SK210	800
175	G.E.	ELC11	750
125	G.E.	Marine	1200
100	G.E.	RC34	2500
100	Westgh.	SK172	850
100	A.C.	E152	575
40	Cr.-Wh.	CMC	1750
40	G.E.	CO2001	600
35	Cr.-Wh.	CM351	700
25	G.E.	C	600
30	Westgh.	SK120	975
30	Cr.-Wh.	CCM	450
30	Westgh.	SK933	1750
30	G.E.	RC31B	1150
25	Westgh.	SK113	850
25	Westgh.	SK180L	1100

MANY OTHERS—1 HP and Up!
ALSO 115 VOLT

AC SYNCHRONOUS
MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

H.P.	Make	Type	P.F.	Spd.
1420	*Westgh.	Syn.	.7	900
800	G.E.	TS984	1.0	1800
700	G.E.	TS		514
320	*Al.-Ch.	Dr. Pf.	1.0	720
300	Cr.-Wh.	Eng.	1.0	300
300	*G.E.	ATI	1.0	720
300	G.E.	ATI	.8	900
275	Ideal		.8	257
250	*Al.-Ch.	Dr. Pf.	1.0	720
230	G.E.	ATI	1.0	600
150	*Westgh.	HB	1.0	300
135	Parkinson			900
125	Kl. Mach.	Syn.	1.0	900
125	Cr.-Wh.	103-S	1.0	900
125	*G.E.	TS	1.0	277
115	K.-M.	KM	1.0	240
100	Cr.-Wh.	103-S	.8	900
100	*G.E.	ATB	.8	900
100	Ideal	SMS	1.0	900
75	G.E.	ATI	1.0	900
40	G.E.	ATB	.8	1200
30	Fynn W	15VRN		1200
15	Century	ABC365	1.0	1200
4	G.E.	AK (25 sy.)		1500

D. C. MOTORS
ADJUSTABLE SPEED
230 Volts (*115 Volt)

H.P.	Make	Type	Speed
25	G.E.	RF-13	500/1000
20	G.E.	C	300/900
20	A.C.	ER-145	300/1200
12.5/15	*Triumph	Planer	225/900
12.5/15	G.E.	RC-116	500/1500
10/15	Reliance	1851	400/1600
10	*Elec-D	7½S	300/1200
10	G.E.	RF-11A	300/1200
10	G.E.	RD-10A	600/1800

CHANDEYSSON ANODIZER
NEW 1000 Amp. 40 volt, type NPT, d/c to 60 HP A-28 Syn. Motor, 3/60/220, 600 RPM, 25°C. continuous.

AC SYNCHRONOUS
GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or higher)

K.V.A.	Make	Type	P.F.	Spd.
1500	G.E.	ATI	.8	900
112.5	*G.E.	ATB	.8	1200
110	Cr. Wh.	103	.8	900
100	*G.E.	ATB	.8	900
60	Fr.-Morse	B	.8	900
55	G.E.	ATB	.8	1200
50	G.E.	ATB	.8	1200

1000 KW M.G. SET
3-UNIT
1—500 KW West. DC Gens., 275/137.5 V. 3 wire, 1820 Amps.
D/C TO
1420 HP West. Syn. Motor, 900 RPM 11,000 V. 60 Cy., 3 ph. S Brg. on Castiron Factory Base.

M. G. SETS

K.W.	Make	A.C.	D.C.
2400	A-C (3-unit)	4800/2400	525
2400	Westgh (3 unit)	4800/2400	600
500	Al. Ch.	2300	250
500	Cr.-Wh.	220/440	250
450	G.E. (3 unit)	2300	125/250
250	West.-G.E.	440	250
200	Ridgeway	2200	250
150	G.E.	2300/440	250
150	G.E.	440	250/375
100	G.E.	440	250
100	G.E.	220	250
100	G.E. Delco	440	120/240
75	Al. Ch.	440	250
60	Al.-Ch.	2300	110
40	Cr.-Wh.	220	125
40	El-P-GE	440	250
20	G.E.	440	250
15	G.E.	220	250
10	G.E.	440	125
10	G.E.	440	250

D.C. TO A.C.

75	Westgh.	110	2300

ROTARY CONVERTERS

1000	G.E.	600 v	DC
500	G.E.	600 v	DC

ENGINE-GENERATOR SETS

KVA	Make	Type	Volts	RPM
300	G.M.	8-268A	480	1200
100	G.M.	6-71RC	480	1200
31	Cum.-Reg.	H-1-6	120/208	1200
25	LeRoi	30-A	120	900
10	Onan	PE2CG	115/230	1800
1½ KW	Kohler	D-7551	110 DC	1000
1	Onan	10L-103	115	

TRANSFORMERS

KVA	Make	Ph.	Prim.	Sec.
2000	Fittsb.	1	12000	2300
1000	Westgh.	3	4800	480
850	Westgh.	3	4160	455
500	G.E.	3	13200	445
300	G.E.	3	13800	240/480
300	G.E.	3	2400	240/480
167	Al.Ch.	1	2400	120/240
100	Al.Ch.	1	2400	120/240
75	Al.Ch.	1	2400	120/240
SMALLER RATINGS			2400 to	120/240

ELECTRIC SHOVEL OR CRANE DRIVE
250 V. - VARIABLE VOLTAGE
1—100 KW DC Hoist Generator
1— 25 KW DS Swing Generator
1— 24 KW DC Crown Generator
Driven by
190 HP Syn. Motor. 3/60/2300 v.
MOTORS
1— 75 HP G.E. MDS106 Hoist
1— 30 HP G.E. MD104½ Swing
1— 30 HP G.E. MD104½ Crowd

HI-PRESSURE PUMPS

GPM	Make	Type	Head
800	Worth.	6DS	925 Ft.
500	Manistee	H	250 Ft.
300	Al.-Ch.	NMZ	800 Ft.

First Source for 42 Years of Quality Electrical Equipment

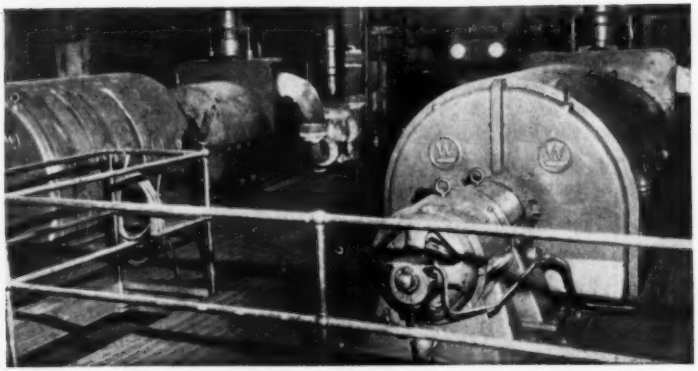
CHICAGO Electric Co.

1320 W. CERMAK RD. • CHICAGO 8, ILLINOIS

2500 KVA — WESTINGHOUSE TURBINE-GENERATOR

Non-condensing — 450# psig. with Changes

A MODERN HIGH GRADE UNIT



Above is our 2500-KVA., Westinghouse Non-condensing Turbo-Generator. It is one of the most modern, best conditioned units we have ever owned. Originally, we had two (duplicates): one has been sold to one of the largest Paper Mill Co.'s, and is giving complete operating satisfaction. Unit is good for 450# psig. and 50# B.P., with moderate changes. Voltage 3/60/2400. Is now in dry storage. Had limited service, always proper maintenance. Inspection Reports, Drawings, Complete Specs. on request.

SPECIALS: PRICED FOR QUICK SALES

3—300-KW., WEST., Turbine Sets, Like New, 450# psig., 2300-V., with Switchboards, Evactors, Etc.

G.E. Turbine only. 2300-V., 250# psig. Cond. A-1.

Condenser, 3640 sq. ft., 2-pass, NEW. Never Used.

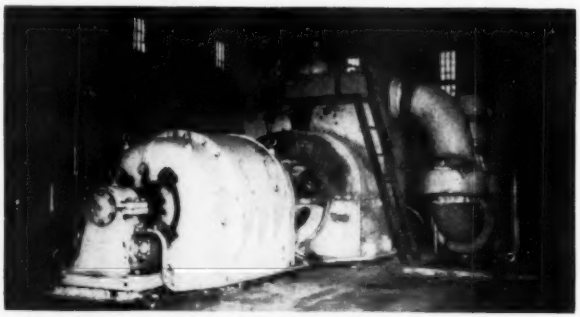
G.E., 2500-KW., Non-cond., 2300, 4160, 6900-V., 150/175 psig., 10/25# B.P., Cond. First Class: Complete.

Fairbanks-Morse Diesel Engine Generating Set, 333 KW., New, 1949. Cond. Perfect.

The 625-KVA., Westinghouse Turbo-Generator, at the right, our own Property, is stored and ready for Immediate Installation. With moderate Changes it is good for 450# psig, 125# back and Voltage is 3/60/2400.

Always used as a Standby unit: Very Limited Service, is like a New Machine.

INSPECTION INVITED.



ADVISE IMMEDIATE INSPECTION IF INTERESTED. ARE YOU?

CONDENSING TURBINE SETS: WE OWN 20 COMPLETE UNITS OUTRIGHT. ALSO HAVE COMPLETE LINES OF BOILERS AND DIESEL ENGINES.

TELEPHONE
WRITE
TELEGRAPH

CHARLES WEAVER

Electrical-Mechanical Engineers

41st Floor Penobscot Building, Detroit 26, Michigan

TELEPHONES:
Woodward 1-1340
" 1-1341
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DRAWINGS, COMPLETE DATA, PHOTOS ON ALL UNITS CHEERFULLY FURNISHED

WHAT DO YOU NEED? • SEND US YOUR SPECIFICATIONS

ELECTRIC MOTORS AND GENERATORS

WAGNER CERTIFIED REBUILT

BACKED BY 46 YEARS OF QUALITY AND SERVICE

For QUALITY-SERVICE-PRICE - - - "Check with WAGNER First!"

OVER 46 YEARS OF EXPERIENCE is back of every machine sold by Arthur Wagner Company. Large stocks and modern facilities insure ample choice and prompt service at reasonable cost. All Wagner "Certified Rebuilt" equipment conforms to standards approved by National Industrial Service Association. Inspect our shop and stock—see why it pays to . . . "Check with Wagner First!"

M-G SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
500	G.E. HCC conv.	2300 AC	275 DC
300	Allis Ch.	2200/440 AC	125/250 DC
300	Whse.*	2300 AC	600 DC
200	Whse.*	2300 AC	275 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Whse.*	2300 AC	275 DC
150	Whse.*	220/440 AC	125/250 DC
105	Century b.b.	220/440 AC	70 DC
100	Whse.*	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	125/250 DC
100	Allis Ch.*	2200/440 AC	60 DC
75	Gen. Elec.	220/440 AC	125 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
50	Whse.	2200/440 AC	250 DC
45	Gen. Elec.*	220/440 AC	60 DC
45	Gen. Elec.	220/440 AC	60 DC
40	Whse.	220/440 AC	125 DC
40	G.E.	220/440 AC	250 DC
35	Cr. Wh. b.b.	220/440 AC	125 DC
30	Elec. Prod.	220/440 AC	50 DC
25	Whse.	220/440 AC	125 DC
25	G.E. b.b. New	220/440 AC	125 DC
25	Reliance b.b.	220/440 AC	250 DC
20	Northw'n.	220/440 AC	250 DC
15	G.E. (3)	220/440 AC	125 DC
15	Star b.b. (3)	220/440 AC	250 DC

*Syn. motor drive.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Gen. Elec.	MPC	230	500
150	Gen. Elec.	MPC	230	500/1200
150	Whse.	SK183	230	1150
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
75	Northw'n	K20	230	1750
60	Cr. Wh.	50H	230	700
60	Reliance b.b.	55T	230	750
50	Gen. Elec.	RLC 204	230	500/1200
50	Gen. Elec.	LC	115	400/800
50	Cr. Wheeler	CMC	230	1750
40	Whse.	SK	230	850
40	Gen. Elec.	RC-32	230	1150
40	Gen. Elec. (2)	CD115	230	575/1150
30/50	Gen. Elec.	CD123	230	575/1150
30	Whse.	SK110L	230	1150
30	Whse. (2)	SK90	230	1700
30	Star b.b.	SB	230	1750
30	Gen. Elec.	RC33	230	775
25	Gen. Elec.	CD85	230	1750
25	Whse.	SK150	230	300/1200
25	G.E. b.b. New	CDM93	115	1150
25	Gen. Elec.	RF13	230	250/1000
25	Whse.	SK	230	1150
25	Reliance b.b.	92T	230	1150
20/25	Whse.	SK160	230	225/900
20	G.E. b.b. (5)	CDM83	230	1150
20	Whse. b.b. (2)	SK90	230	900
20	Gen. Elec. (2)	CD83	230	1750

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC
- FREQUENCY CHANGERS
- CIRCUIT BREAKERS, AC & DC.
- SPEED REDUCERS

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec.	MPC	275	700
300	Whse.	SK	600	900
150	Whse.	SK191	125/250	900
125	Gen. Elec.	RC31	250	875
105	Century b.b.	1500 amp.	70	1200
100	Gen. Elec.	C	250	750
60	Gen. Elec.	LC	250	700
50	Allis Ch. (2)	EW	125/250	1200
50	Cr. Wheeler	50H	250	900
40	Whse.	SK	250	1200
30	Gen. Elec. (2)	RC32	250	1500
30	Gen. Elec.	RC32	250	1200
25	G.E. b.b. New	CDM93	125	1750
25	Whse.	SK	250	1450
20	Gen. Elec. (2)	RC	125	1150
20	Gen. Elec. b.b.	CDM	250	1750
15	Cr. Wheeler b.b.	CD	125	1900
15	Star bb. (6)	SQ	250	1500

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn. cond.		4000/2300	900
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
500	El. Machy.		480	900
485	Allis Ch.	1 brg.	480	600
312	Gen. Elec.	ATB	240/480	600
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	240/480	600
150	Whse.		2300/480	600
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
90	Gen. Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
56	Gen. Elec.	ATB	240/480	1200
31	Whse. b.b.	late	120/208	1200
10	Kato New (15)	b.b.	127/220	1800

A. C. MOTORS — SLIP RING
3 Phase 60 Cycle 220 or 440 Volts

QU	HP	Mfr.	Type	Speed
1—	600	Gen. Elec.	1M	360
1—	500	G.E. 3 brg.	I-M	450
1—	400	Gen. Elec.	I-M	514
2—	350	Gen. Elec.	2M-17A	720
1—	350	Whse. 2200V.	CW	450
1—	300	G.E. 2200V.	I-M	1800

1—	250	Allis Ch. 2200V.	ANT	514
1—	250	Cr. Wheeler	WR	600
1—	200	F. Morse b.b. 2200V	HV-24C	900
1—	200	Gen. Elec.	IM-17	514
1—	200	Gen. Elec.	I-M	360
1—	200	Gen. Elec.	I-M	600
1—	150	G.E. 2200/4400V. Vert.	I-M	1200
1—	150	Gen. Elec.	I-M-17	450
1—	150	G.E.	IM-16	600
1—	150	Allis Ch. 2200V.	ANT	720
1—	125	G.E. 2200V	IM-15	720
1—	125	Fair. Morse b.b.	HV246B	600
2—	125	Gen. Elec.	I-M-15	600
1—	125	Allis Ch.	ANT	900
2—	100	Gen. Elec. New	M6324	1200
2—	100	Gen. Elec.	MT2556	900
2—	100	Gen. Elec.	I-M	514
2—	100	Gen. Elec.	I-M	1800
2—	100	G.E. 2200V.	MT553	1200
1—	100	G.E. Vertical	MT553	1200
1—	100	Cr. Wheeler	SR	600
1—	100	Northwestern	HW	1800
1—	75	Gen. Elec.	MT558	600
5—	75	Gen. Elec.	MT552	900
1—	75	Whse. 2200V.	CW	600
1—	75	Gen. Elec.	MT343	1800
1—	75	Whse.	CW	720
3—	60	Gen. Elec. enclosed	I-M	514
1—	60	G.E. TEFC b.b.	M-6326	720
1—	60	Fair. Morse	BV	720
1—	60	Whse. 2200V.	CW716C	900
2—	50	Gen. Elec.	MT542	900
1—	50	Gen. Elec. int.	TC	600
3—	50	Gen. Elec.	MT556	600
2—	40	Whse.	CW636A	1200
1—	30	G.E. Int. duty	MTC5312	1200
2—	30	Gen. Elec.	MT326	1200
2—	30	Gen. Elec.	MT332	900
1—	25	Gen. Elec. Int.	MTC5526	720
3—	20	Whse. b.b. New	CW364	1800

A. C. MOTORS — SYNCHRONOUS

HP	Mfr.	Type	Volts	Speed
750	Whse. SPF	Cond.	4000/2200	900
700	Gen. Elec.	TS7459	2200	514
450	Whse.	SPF	2300	900
300	Whse.	G	2200/440	600
275	G.E. 25 cycle	ATI	220/440	750
225	El. Machy.	BRKT	220/440	1800
220	G.E. 3 brg. SPF	ATI	220/440	600
220	G.E.	ATI	2300	900
200	Allis Ch.	SPF	2200/440	720
200	G.E.	TS	220/440	150
190	El. Machy.	3 brg.	220/440	514
175	Gen. Elec.	ATI	2200/550	450
175	Whse.	2 brg.	220/440	360
150	Gen. Elec.	ATI	220/440	900
125	El. Machy. (3)		220/440	1800
120	Burke b.b. SFF	AC19	2200/440	1200
100	American b.b.	VQH	220/444	1 00
90	Gen. Elec.	TS7545	220/440	1200
80	Gen. Elec.	ATI	2200/440	1200

A. C. MOTORS — SQUIRREL CAGE
3 Phase 60 Cycle 220 or 440 Volts

QU	HP	Mfr.	Type	Speed
1—	500	G.E. 4000/4000 V.	I-K	1800
1—	300	G.E. 2300V.	KTF561	1800
1—	300	Gen. Elec.	I-K	600
2—	250	Whse. 2200V.	CS	1200
1—	250	Gen. Elec.	IK-17	600
1—	250	G.E. 2200/4400V.	KT412	450
1—	200	G.E. 4000/2200/440V.	KT412	360
1—	200	Gen. Elec.	IK-17	514
1—	200	Reliance b.b. New	B6085S	1200
2—	200	Gen. Elec.	I-K	600
2—	200	Gen. Elec.	I-K-813B	1800
1—	200	Whse. 2200V. Ex. Pf.	CS81208	1200
1—	150	Gen. Elec.	KS58	900
1—	150	Allis Ch. 2200V.	ABW	3600
2—	150	Reliance b.b. New	B5085	1800
1—	150	Reliance b.b. New	C8085	900
1—	150	Gen. Elec.	KT549	1800
2—	150	Gen. Elec. 2200V.	IK-15A	720
1—	150	Reliance b.b. New	B6085	1200
1—	150	Gen. Elec. TEFC b.b.	K63638	1200
1—	150	Whse.	CS	720
2—	125	Al. Ch. 2200V. b.b.	ABX-826	900
1—	125	Rel. TEFC New	B6085S	1800
2—	125	Gen. Elec.	K-858	900
2—	125	Allis Ch. Vertical	ABV226	1200
1—	125	G.E. New b.b. HT	KG6324	1200
1—	125	Con. 2200V. b.b.	SC	1800
2—	125	G.E. 2200V. TEFC	K6326	3600
2—	100	Reliance b.b. New	5084S	1800
1—	100	Reliance TEFC New	B5085	1200
1—	100	Whse.	CS	720
1—	100	Gen. Elec.	IK-15	600
2—	100	Gen. Elec.	IK-14	900
1—	100	Reliance b.b. New	C5085	900
1—	75	Whse. Expl. Prf. New	CS505	1200
1—	75	Wagner	22VRM	1200
1—	75	Rel. TEFC New	5048	3600
1—	75/90	Gen. Elec.	IK	3600
1—	75	G.E. TEFC 2200V. New	K-6325	900
2—	75	Gen. Elec.	I-K-14	600
2—	75	Reliance b.b. New	CB415S	1800
1—	75	Reliance TEFC	C5084	1200
3—	75	G.E. Vertical	KT543	1200
3—	75	U.S. b.b. NEW	CS505	1200
3—	60	G.E. 2200V.	KT533	1800
2—	60	Gen. Elec.	KT546	900
3—	60	F. Morse b.b.	HO-166B	900
1—	60	Gen. Elec.	KT556	450
1—	60	Reliance b.b. New	CC505	900
1—	60	G.E.	KT556	450
1—	60	Gen. Elec.	I-K	600
3—	60	G.E. Vertical	KT536	1200
2—	60	Reliance b.b. NEW	B504	1800
1—	60	Allis Ch. TEFC	ABZ	3600
2—	50	Howell b.b.	8CBB	3600
2—	50	Gen. Elec.	KT546	720
2—	50	Gen. Elec.	KT532	600
1—	50	G.E. Vertical	KT544	720
1—	50	Star b.b.	N505	1200/720
2—	50	Reliance b.b. New	CC504U	900
2—	50	Whse	CS	1200
2—	50	Howell TEFC	K445	1800
1—	50	Gen. Elec.	KT537	1800
1—	50	Reliance b.b.	C505	600
1—	50	Whse. hitorq	CS505	900
2—	40	G.E. 2200V.	KT323	1800
2—	40	Reliance b.b. New	CR404	1800
2—	40	Reliance b.b. New	CB504	3600
2—	40	Gen. Elec.	KT532	1200
4—	40	Gen. Elec.	KT536	900
2—	40	Gen. Elec.	KT544	600
6—	40	Whse. b.b.	CS-504	1200/900
1—	30	Louis Allis	HD	900/450

A. C. MOTORS — 25 CYCLE

HP	Mfr.	Type	Volts	Speed
275	G.E. syn.	ATI	440	750
150	Whse.	HF	440	500
60	Allis Ch.	ABY	440	1500
50	Gen. Elec. Int.	MTC5337	440	720
50	Gen. Elec.	I-K	440	750
39	Gen. Elec.	MT343	440	750

Arthur Wagner Co.

1435 W. RANDOLPH ST. MOnroe 6-7808 CHICAGO 7, ILLINOIS

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The BOSTON METALS Co. *offers* BOILERS, MILL MOTORS & TURBO-GENERATORS *at Bargain Prices*

2 MODERN PACKAGE TURBO-GENERATOR SETS

with self contained condensers

1350 K.V.A.—BUILT 1943

TURBINES: Westinghouse, Serial No. 2-A-9593-99 & 2A-9593-100. Impulse reaction type—7 stages condensing—3500 H.P.—4800 R.P.M. Steam pressure 440 P.S.I.—Exhaust pressure 27½" vacuum. Temp. 740°—weight 13000 lbs.

GENERATORS: Westinghouse, Serial No. 109S20P900 & 108S20P900—3 phase two pole type—2550 K.V.A.—82½ cycles—2210 volts—100% P.F.

THESE GENERATORS CAN BE RE-WOUND FOR APPROX. 1350 K.V.A.—3 PHASE—60 CYCLE 2300 OR 440 VOLT OPERATION WITH TURBINE SPEED REDUCED TO 3600 R.P.M.

CONDENSERS: Westinghouse—2 pass—2200 Sq. ft.—vacuum 27½"—¾" tubes 12 ft. long—weight, 26,700 lbs. Condensers mounted below turbine. Oil Pump & oil cooler mounted directly on unit. Unit completely mounted on prefab sub-base.

THESE UNITS CAN BE DELIVERED RE-WOUND IN A VERY SHORT TIME.

6 B&W BOILERS

cross drum sectional header

BUILT 1943 — IMMEDIATE DELIVERY

Heating Surface	11417 sq. Ft.
Design Pressure	200 P.S.I.G.
Working Pressure	200 P.S.I.G.
Capacity	75,000 lbs./hour
Steam Temperature	Saturated
Furnace Volume	1024 Sq. Ft.
Feed Temperature	200°
Oil Burners	8 per boiler

BOILER DIMENSIONS

19' 4" wide, 16' 4½" high, 15' deep

BOILER TUBES

1667—1¼" straight, 12' 2" long
825—1¼" bent; 122—2" straight
(first 2 rows above fire box)
Downcomer & Uptake Tubes
4" & 4½" bent

WATER WALL SIDES IN FURNACE

HYDROSTATICALLY TESTED NOV. 1951 BY PRUDENTIAL LIFE INSURANCE CO.

3 MODERN TURBO—GENERATOR SETS

250 K.W.
440/3/60
1200 R.P.M.

TURBINES: Worthington-Moore, 440 lbs. W.P., 740° T.T., Serial No. 7454—7452—7432, type 54—5 stage condensing—28.5" Vac.—turbine speed 6097—gear speed 1200. Westinghouse-Moore reduct. gear 6097/1200.

GENERATORS: Westinghouse, 312 K.V.A.—250 K.W.—3/60/440 1200 r.p.m.—400 amps.—80% P.F.—125 volts d.c. excitation—exciters direct connected 5.5 K.W.

UNIT IS MOUNTED ON PRE-FAB SUB-BASE. BUILT-IN OIL COOLERS. THESE ARE MODERN UNITS RECENTLY REMOVED FROM A NAVAL VESSEL.

16 MILL MOTORS—*Complete With All Controls*

50 H.P. — 230 VOLTS D.C. — 600 R.P.M.

The BOSTON METALS Co.

313 E. Baltimore Street — Baltimore 2, Md.

Phone Curtis 5050

All items can be seen at the Boston Metals Co. Marine Warehouse, Curtis Bay, Baltimore

WORLD'S LARGEST INVENTORY

Established 1934 — D & B Rated

TRANSFORMERS
WORLD'S LARGEST INVENTORY

KVA	PV	SV
1—3750	22000	600
1—3000	22000	550
3—2500	27600	2300
3—2000	45/50000	2300
5—1500	33000	2300
1—1500	2200	600
3—1000	66000	7200
4—1000	33000	2300
3—1000	13800	230/460
1—1000	2200	220 Delta
3— 833	2300	575
2— 833	13800	460
4— 750	2200	244/488
3— 667	13200	2300
1— 667	13200	480
6— 667	11500	460
3— 667	6600	2300
1— 500	13800	230/115
1— 500	4600	460
2— 500	11000	2300
1— 500	34500	230/460
14— 580	22000	190
1— 450	11000	230
1— 450	11000	460
3— 400	2300	440/220
3— 400	1980	244/488

100 NEW, 15 KVA, Allis-Chalmers air-cooled transformers, 460/230 primary; 115/230 secondary.

3—1250 KVA, G.E. transformers, 11,000 Pr. V. with 4 taps on 33,000, 2200 Sec. V., 25 cy. 1 ph. (O.K. for 60 cycle). Ser. 2,297,476-7-8.

PARTIAL LIST—2000 UNITS IN STOCK FROM ONE TO 333 KVA
ALSO AIR COOLED AND SWITCH GEAR

SQUIRREL CAGE—60 CYCLE

HP	Speed	Make
500 (3)	514	West.
450	720	G. E.
400 (2)	514	West.
300	600	West.
250 (2)	3600	G. E.
250	1200	Al. Ch.
250 (6)	900	West.
250 (2)	720	Open
200 (2)	1800	West. TEFC
200 (2)	1800	Wag., Rel.
200	600	Al. Ch.
150	900	G. E.
150	400	G. E.
125 (5)	1800	Al. Ch.
100 (2)	1800	West.
100	1200	G. E.

P.S. We stock 3500 new and rebuilt 1 HP to 100 HP

S. C. & S. R.—25 CY.

Quan.	HP	Speed	Make
1	650	365	S. R.
1	300	375	S. R.
1	300	750	S. C.
1	200	500	S. C.
5	200	500	S. R.
1	200	720	S. R.
1	200	750	S. C.
3	150	500	S. R.
10	135	1500	S. C.

Plus 872 smaller units 1 HP to 125 HP

MOTOR GENERATOR SETS
AC-DC

Quan.	KW	Make	Volts
1	1500	G. E.	300
2	1000	G. E.	600
1	1000	G. E.	250
1	1000	West.	250
1	750	Al. Ch.	275
1	600	G. E.	250
1	500	West.	125
3	500	West.	250
2	500	G. E.	250/275
1	500	G. E.	275
1	400	West.	125/250
1	400	West.	500
1	325	G. E.	500
2	300	West.	275
1	300	West.	550
2	200	West.	600
1	200	West.	250
1	170	G. E.	125
1	150	West.	125/250

Plus 238 sets from 1 KW to 150 KW in stock.

AC GENERATORS—ALTERNATORS—CONDENSERS

Quan.	KVA	HP	RPM	Cycle
1		2500	720	60
1		2500	900	60
1		1875	600	40
2		1500	900	60
1		1500	1200	60
3		1250	720	60
2		1000	600	60
1		1000	720	60
1		800	900	60
1		720	900	60
1		710	720	60
2		650	129	60
1		500	720	60
1		412	225	60
1		400	450	60
1		400	250	25
1		375	750	25
2		375	1200	60
1		350	720	60
1		300	750	25
1		312	1200	60
1		300	600	60
1		300	180	60
1		280	1200	60

Plus 78 smaller units from 3 KVA to 250 KVA

DC—ADJ. SPEED—230 V.

Quan.	HP	Make	Speed
1	650	G. E.	750/2000
1	300	G. E.	400/ 800
1	250	West.	250/ 675
4	250	West.	540/3000
1	125/190	G. E.	260/ 400
1	150	West.	320/ 580
1	150	West.	400/ 800
1	150	Rel.	400/1200
1	100/150	West.	500/ 750
2	100	Rel.	575/1150
2	100	West.	450/1000
1	60	El. Dyn.	525/1050
2	30/71	West.	560/ 780
1	50/60	G. E.	220/1000
1	50	West.	565/ 975
2	50	Diehl	400/ 800
1	50	Cr. Wh.	300/1200
1	25/50	G. E.	300/1200
1	35	G. E.	250/1000
1	30	Rel. TEFC	400/1200
2	25/30	Cr. Wh. TEFC	500/1500
3	25	G. E.	500/1500

Plus 827 smaller units 1 HP to 25 HP

SLIP RING MOTORS

Quan.	HP	Speed	Make
1	600	1800	G. E.
1	500	1800	G. E.
1	500	514	Al. Ch.
1	400	514	G. E.
1	400	455	West.
1	300	500	G. E.
1	300	450	G. E.
1	300	600	G. E.
2	250	600	G. E.
1	250	480	G. E.
2	200	600	G. E.
3	200	450	Burke
1	150	460	G. E.
1	150	720	G. E.
1	150	700	G. E.
1	150	900	Al. Ch.

Plus 837 smaller units 1 HP to 125 HP

ROTARY CONVERTORS

Quan.	KW	Make	Speed	Volts
3	500	G. E.	1200	250
3	400	West.	1200	250
1	300	West.	1200	250

P.S.—We Stock Explosion-Proof Motors—Class 1-D & 2-G

CONSTANT SPEED—230 V.

HP or KW	Make	Speed
1500 KW	West. 125/250 V.	514
400 HP	El. Dyn.	1500
400 HP	G. E.	450
300 KW	West. 125/250 V.	1200
300 KW	G. E. 170 V.	1200
250 KW	Al. Ch.	750
150 KW	West. 125/250 V.	750
150 KW	G. E.	1200
150 HP	West.	1615/1785
125 HP	Star	1200
120 KW (2)	G. E.	1200

Plus 675 smaller units 1 HP to 100 HP also 115 V. & 550 V. DC.

Note: We Stock 6000 New Motors, Controls, Frequency Changers
SEND US YOUR INQUIRIES!

ELECTRIC EQUIPMENT COMPANY

PHONE LD 65

New and Rebuilt — ROCHESTER, N. Y. — 1 H. P. to 2500 H. P.

MOTORS | MG SETS | TRANSFORMERS | CONTROLS | COMPRESSORS

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

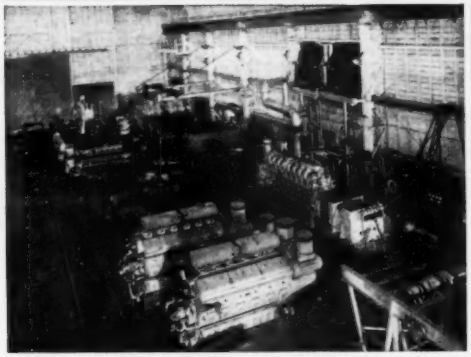
So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

A.G.

SCHOONMAKER CO., INC.

52 CHURCH ST., NEW YORK 7, N. Y.

PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1500	Fairbanks Morse	33E16	2000	300
1230	Nordberg	F6G168SC	1750	327
1136	Fairbanks Morse	38D	1600	720
1000	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
500	Alco	6-12-1/2x13T	750	600
500	Worthington	EE	750	327
500	General Motors	8-567	720	720
340	Baldwin	VO-6	510	450
320	Buckeye	80	480	600
300	Enterprise	DSG-6	450	450
300	General Motors	8-268A	450	1200
264	Superior	KNA	396	514
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
60	General Motors	6-71	90	1200
50	Caterpillar	D-8800	76	1200

ALTERNATING AND DIRECT CURRENT UNITS STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

TURBO GENERATOR UNITS
3 Phase 60 Cycle

25000 KVA G.E. Cond. 13200 V. 250-lb.
6250 KVA A. Ch. Cod. 4160 V. 200-lb.
5000 KVA G.E. Non-cond. Extr. 13800 V. 600-lb.—125-lb. Extr. 50-lb. Exh.
5000 KVA West. Cond. Extr. 600 V. 300-lb.—25-lb. Extr.
2500 KVA G.E. Cond. 2300 V. 150-lb.
1562 KVA A. Ch. Non-cond. 480 V. 200-lb.—15-lb. Exh.
1250 KVA West. Cond. Extr. 480 V. 200-lb.—25-lb. Extr.
625 KVA West. Non-cond. 480 V. 200-lb.—10-lb. Exh.

BOILERS

100,000 lbs. B. & W., 450 lbs.
50,000 lbs. B. & W., 400 lbs.
30,000 lbs. B. & W., 400 lbs.

ENGINE GENERATOR UNITS
3 Phase 60 Cycle

750 KVA Ames vert. Uniflow 2300 V.
625 KVA Skinner vert. Uniflow 480 V.
625 KVA Skinner Uniflow 240 V.
312 KVA Skinner Uniflow 240/480 V.

DIESEL GENERATOR UNITS
3 Phase 60 Cycle

1250 KVA Nordberg, 2400 V. 257 rpm.
700 KVA Fair.-Morse, 2400 V. 300 rpm.
600 KVA Fair.-Morse, 2400 V. 300 rpm.
475 KVA Coop.-Bess., 2400 V. 400 rpm.
375 KVA Chic.-Pneu., 2400 V. 257 rpm.

SYNCHRONOUS CONDENSER
3 Phase 60 Cycle

7500 KVA G.E., 13800/6900/4000/2300 V. 720 rpm.

TRANSFORMERS
1 Phase 60 Cycle

3—1000 KVA G.E. 13200/2300 volts
3— 667 KVA Pitts. 13200/2300 volts
3— 500 KVA Pitts. 11500/550 volts
3— 500 KVA West. 13200/2300 volts
3— 200 KVA G.E. 13200/2300 volts
3— 100 KVA Pitts. 12500—120/240 volts

RECTIFIERS
3 Phase 60 Cycle

4500 KW A. Ch. 13800—600 V. DC
1500 KW West. 44000—1500 V. DC
1000 KW G.E. 13200—600 V. DC
750 KW G.E. 44000—1500 V. DC

GENERATORS
3 Phase

2250 KVA G.E. 60 cy. 480 V. 3600 rpm.
2859 KVA (3) G.E. 240 cy. 2300/4150 V. 4800 rpm.

INTERNATIONAL POWER MACHINERY CO.

1609 UNION COMMERCE BLDG. Telephone: MAin 1-9514 CLEVELAND 14, OHIO

STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Ekono Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Clarage Forced Draft Fans, Sturtevant Induced Draft Fans, Smoke Stacks. Good for 250# pressure by Hartford.

1—705 HP Stirling 4 drum Boiler with B&W Superheater, Green Chain Grate Stoker, Sturtevant Economizers, Sturtevant Induced Draft Fan, with Smoke Stack. Good for 250# pressure by Hartford.

2—8000 HP Webster Water Heaters.

1—McCaslin Pivoted Bucket Conveyor System for handling coal and ashes. Approximately 300' long.

6—Steel Coal Bunkers, 80 tons each.

1—36" Wheeler Single Stage Circulating Pump, 30,000 GPM direct connected to 200 HP Allis-Chalmers Motor, 3/25/440, 360 RPM. (Has extra impeller for 15,000 GPM)

1—4"x8" Dayton-Dowd Centrifugal Pump direct connected to 125 HP General Electric-Curtis Steam Turbine.

1—100 KW General Electric 125 Volt DC Generator direct connected to a General Electric-Curtis steam Turbine, 2-stage with reduction gear, type SG, 3600 to 1200 RPM.

1—Type 1A-90 Wheeler Turbo Air Pump direct connected to 75 HP General Electric-Curtis 2-stage Steam Turbine, 1750 RPM.

1—6" Wheeler Centrifugal Condensate Pump direct connected to a 20 HP General Electric-Curtis 2-stage steam Turbine, 1800 RPM.

1—Combination Circulating Pump and Condensate Pump driven by 190 HP General Electric single stage Steam Turbine through a Westinghouse reduction Gear, 3600 to 700 RPM.

1—4" 2-stage LeCourtney Centrifugal Pump, 200 GPM 800' Head at 3/00 RPM direct connected to 35 HP Westinghouse Steam Turbine.

1—3000 KVA General Electric Synchronous Converter, type MCC, 6 phase, 25 cycle, 600 RPM, 600 Volts DC with [illegible] KVA General Electric transformer, 3 phase, 25 cycle, 6600/13200-440 Volts with starting panel and all instruments.

1—1000 KVA General Electric Synchronous Converter, type MCC, 6 phase, 25 cycle, 750 RPM, 600 Volts DC with [illegible]-1000 KVA General Electric transformer, 3 phase, 25 cycle, 13200/440 volts with starting panel and instruments.

1—500 KW Westinghouse Synchronous Converter, 6 phase, 60 cycle, 1200 RPM, 600 Volts DC with starting panel and instruments.

1—4000 KVA Westinghouse Transformer, 3 phase, 25 cycle, 13200/6600 volts.

7—750 KVA Westinghouse Transformers, single phase, 25 cycle, 7620/3600 volts to 13200 volts.

1—Kennecott Pressure Type Industrial Water Filter.

1—50-Ton Electric Traveling Crane—55'3½" Span.

1—25-Ton Hand Operated Traveling Crane—57' Span.

Send for Complete Inventory

MORSE BROS. MACHINERY COMPANY

2900 BRIGHTON BLVD.

P.O. Box 1708, DENVER, COLORADO

MOTOR GENERATORS

1—400 KW G.E. Syn. 600 V. 720 RPM
1—350 G.E. Syn. 250 V. 1200 RPM
2—300 KW (DUPL.) WEST. Syn. 250 V. 1200 RPM
1—200 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW RIDGWAY Syn. 250 V. 900 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM
1—150 KW WEST. Syn. 250 V. 1200 RPM
1—100 KW RIDGWAY Syn. 250 V. 1200 RPM
2— 50 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW WEST. Syn. 250 V. 1200 RPM
1—300 KW WEST. Syn. 250 V. 1200 RPM
2—300 KW AL-CH. Syn. 250 V. 1200 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM

WALLACE E. KIRK COMPANY

502 Grant Bldg., Pittsburgh 19, Pa.

COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St. St. Louis 1, Mo.

ELECTRICAL EQUIPMENT

Electrical Equipment—Rebuilt and Guaranteed—Motors—Generators—M-G Sets—Transformers—Controls—

REBUILT AND GUARANTEED

PROMPT SHIPMENT—PARTIAL LISTING

250 VOLT DYNAMOMETERS
Cradle Type With Scale and Control
Write for Complete Specifications

Qu.	Make	HP	RPM	Type
1	G.E.	150	2200/5000	TLC-50
2	West.	150	2200/5000	SK-131
1	G.E.	200	1200	C

SLIP RING MOTORS—3 Ph., 60 Cy.

Qu.	HP	Speed	Volts	Make	Type
6	7½	850	440	G.E.	[illegible]
2	10	1150	440	West.	[illegible]
2	10	870	440	G.E.	[illegible]
2	15	850	440	G.E.	[illegible]
1	15	870	440	West.	CW-950
1	15	850	440	West.	CW-948
1	20	1150	440	West.	CW-965
2	20	1150	440	G.E.	[illegible]
2	20	850	440	Wagner	[illegible]
1	30	850	440	West.	CW-946
1	30	1150	440	West.	CW-963
1	30	850	440	G.E.	[illegible]
2	40	1150	440	Wagner	[illegible]
1	40	850	440	West.	CW-944
1	50	850	440	G.E.	[illegible]
1	50	1150	440	West.	CW-961
1	50	870	440	G.E.	[illegible]
1	50	1150	440	G.E.	[illegible]
1	60	850	440	West.	CW-942
1	60	870	440	West.	CW-960
1	60	870	440	G.E.	[illegible]
1	75	1150	440	G.E.	[illegible]
1	75	850	440	West.	CW-958
1	75	870	440	G.E.	[illegible]
2	100	1150	440	G.E.	[illegible]
1	100	850	440	West.	CW-956
1	100	870	440	G.E.	[illegible]
1	125	1150	440	G.E.	[illegible]
1	125	850	440	West.	CW-954
1	125	870	440	G.E.	[illegible]
2	150	1150	440	G.E.	[illegible]
1	150	850	440	West.	CW-952
1	150	870	440	G.E.	[illegible]
1	200	1150	2200	G.E.	[illegible]
1	200	850	2200†	G.E.	[illegible]
1	300	900	440	G.E.	[illegible]
2	300	850	2200	G.E.	[illegible]
1	300	1770	2300	G.E.	[illegible]
1	400	865	440	West.	CW-[illegible]
1	900	1770	440*	G.E.	[illegible]
1	700	735	4000†‡	West.	CW-[illegible]

220 Volt motors can be reconnected for 440 volts. †Intermittent rating. ‡125 cycle.
**New. [illegible] Also 440 or 550 volts.
*Also 2300 volts.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding. Direct Connected Exciter.

Qu.	KVA	RPM	Make	Volts
2	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qu.	HP.	Speed	Make	Type
10	3	850	Reliance	T-23T
6	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-66
2	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al. Ch.	ED-80
2	10	850	West.	SK-94
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
1	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20**	1450	G.E.	CDM-83
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
1	20**	1450	G.E.	CDM-83
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1150	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101

230 VOLT ADJ. SPEED D.C. MOTORS

Qu.	HP.	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
1	12½	280/840	West.	SK-130
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1200	West.	SK-163
1	75	375/750	Cr. Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al. Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/500	West.	SK-220
2	375	350/500	G.E.	MPC

**New

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing.

Qu.	HP	RPM	Volts	Make	Type
3	3	1160	440	L.A.	JS-254
1	5	1730	440	G.E.	K-254
2	7.5	1740	440	G.E.	K-284
1	10	1735	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-4058

SPLASHPROOF, BALL BEARING

Qu.	HP	RPM	Volts	Make	Type
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	15	1150	440	L.A.	FX-365
1	50	1760	440	L.A.	FX-445A
1	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
1	150	880	440	L.A.	FF-1368
1	150	700	440	G.E.	KF-6335

OPEN TYPE MOTORS

Qu.	HP	Speed	Volts	Make	Type
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
1	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KT-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
1	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
2	25	575	440	G.E.	K-3648
3	30	3550	550	G.E.	FT-313
1	30	1755	220	G.E.	CS-644
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	50**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-585C
2	40	900	2300	G.E.	FTR-538
4	50**	1750	440	Wagner	RPS-405
2	60*	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
2	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-352B
1	100	580	2300	G.E.	KT-454
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AN
1	125	1750	2200	Al.Ch.	AR
1	125	435	440	Al.Ch.	AR
2	125	400	2300	G.E.	1-17-FR
1	200	580	550†‡	G.E.	KT-5668
2	300	867	2200	West.	CS-394
1	500	1200	140	G.E.	KTP-567
1	700	1800	2300/ 4000	West.	CS-4-39D12

220 volt motors can be reconnected for 440 volts.
**New. ***2 Phase. ‡‡Reconnectable for 440 volts.

MOTOR GENERATOR SETS
125 and 250 Volts D.C.
(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	380/220‡
10	West.	1750	125	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440
15	West.	1750	125	2200/440
25	G.E.	1200	125	220/440
30	Al. Ch.	1750	125	220/440
50	G.E.	1720	125	220/240†
75	G.E.*	1200	125	220/240
100	West.	1160	125/250	2300/4100

Note: 3KW, 5KW & 7.5KW, 250V Sets Available.
**New. *Synch. Motor Driven. †50 Cy. 125 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVENUE • CLEVELAND 14, OHIO

Motors—Generators—M-G Sets—Transformers—Controls—Electrical Equipment—Rebuilt and Guaranteed

MOTORS - M.G. SETS - CONTROLS

NEW AND GUARANTEED REBUILT

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
600	1800	2300	G.E.	100%
400	900	2300	Whse.	80%
250	200	440	G.E.	85%
200	900	400	E-M	80%
150	600	400	G.E.	100%
150	900	2300	G.E.	100%

SLIP RING

HP	RPM	Volts	Mfg.
700	514	2300	G.E.
500	1200	220/440	Elliott (new)
350	450	2300	Whse.
300	600	220	G.E.
200	450	2300	Burke
100	1160	440	G.E.
50	720	220	Whse.
40	900	220	G.E.

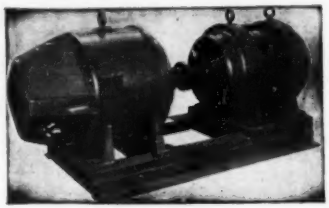
NEW DIRECT CURRENT

230 volt-dripproof

Qu.	HP	RPM	Mfg.	Frame
1	2/3	690/2660	G.E.	284
10	5	850/1700	G.E.	CD-66
3	7½	575/1725	G.E.	CD-77
1	7½	1750	Rel. (TE)	14T
1	10	575/2300	L.A.	4051

CRADLE TYPE DYNAMOMETERS

1—225 HP, Whse., 250 v. D.C., 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.
1—150 HP, Whse., 275 v. D.C., 3000/4000 RPM, Frame 121, complete with all necessary control.



M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	125/250	2300	Whse.
400	125/250	2300	Whse.
250	240	2300	G.E.
150	250	440	Whse.
100	275	2300	Whse.
50	250	440	G.E.
40	250	220/440	G.E.
30	125/250	2300/4000	G.E.
15	230	220/440	G.E.
7½VS	250	220/440	Rel.
3VS	250	220/440	Rel.

NEW MAGNETIC SLIP RING CONTROL

1—ALLIS 250 HP, 440 volt (125 HP, 220 volt) Reversing, 7 accel. steps, main line air ckt. brkr., fully magnetic, open or enclosed.

230 V. DIRECT CURRENT

Reconditioned & Guaranteed

HP	RPM	Mfg.	Brgs.
100	450/1350	Whse.	SI.
65	400/1200	Rel.	SI.
50	300/900	G.E.	SI.
50	500/1500	G.E.	SI.
40	400/1200	Rel. (TE)	Ball
35	400/1200	Ideal	SI.
30	250/1000	Whse.	S.SI.
30	350/1050	Whse.	SI.
30	500/1500	C-W (TE)	BB
30	500/1500	Rel.	Ball
30	600	Whse.	SI.
25	500/1500	C-W	Ball
25	600/1350	Rel.	Ball
25	690	Rel.	Ball
20	250/1000	Whse.	SI.
20	300/1200	Rel.	Ball
20	500/1500	G.E.	SI.
15	250/1000	G.E.	SI.
15	400/1600	Whse.	SI.
15	575/1725	L.A.	Ball
15	650/1650	G.E.	SI.
15	700/1350	Rel.	Ball
10	300/1200	Whse.	SI.
10	400/1600	Whse.	SI.
10	600/1200	Rel. (TE)	Ball
10	850	Rel.	Ball
7½	200/1200	Whse. (TE)	Ball
7½	300/900	G.E.	Ball
7½	400/1600	Rel.	SI.
7½	400/1600	Whse.	Ball
7½	600/1800	Rel. (TE)	Ball
7½	1150	G.E.	SI.
5	400/1200	C-W	SI.
3	850/1700	Rel.	Ball

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WAlbridge 1195

BOSWICK ELECTRIC CO.

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165—GRISCOM-RUSSEL "G-FIN" Tubes with return bends, grd. joints, unused.
172—BELL & GOSSETT Heat exchangers, UNUSED, shells 5½" ID x 54" lg, tube bundels ⅝" tube
2—SCHUTTE & KEORTIG ROTAMETERS. Universal, UNUSED, 3½x30" glass Ø-425 Cl., Cl, unused.
1—SONTAG Electro-dynascope balancing & dynamic testing machine, incomplete. Used.
6—RECTIFIERS, Federal T & R Co., UNUSED, 24/28 V, 130 Amp cont. output, 3 ph, 60 cy, 208-220 V input with mag. switches, amp & voltmeters, 6 pos., unused, $295 ea.
164—ROTARY CONVERTERS, 150 VA, used, 115 V, 2.5 A. D.C. input, 110 V, 1.5 A, A.C. output, Janette.
225—GEAR-HEAD, 100 W, 12/28 AC DC input, Delco motors, 0/25 RPM output, Unused.
230—UNIVERSAL, BALL BEARING TOTALLY ENCLOSED, Unused, 0/10,000 RPM, 12/36 volt, motors.
38—TRANSFORMERS, MALONEY 220/440 HV & many taps to 110/220, dry type OD, unused, 1½ KVA.
6—VOLTAGE STABELIZERS, GE Cat. 69G102, 5 KVA, 95/135 V input, 110/115/120 V, 1 ph, Unused.
52—ITE Circuit Breakers, Unused, 600 V, 115 Amp, 1 p, Close coil 115 V, KJ-6185, UNUSED.
5—600 AMP 1800 V. GE, CR3208-L3CB, Cam switches (controllers) UNUSED.
7—25 KVA, TRANSFORMERS, GE Type HBA, Self. pro., unused, 6600/11430Y HV to 120/240, no taps, Form KH, unused.
3—125 KVA, used, 6600/11430 HV, taps, 480 V sec., Pittsburg, OISC transformers.
1—SCHUTTE & KEORTIG STAINLESS STEEL tumbling barrel (mixer) 30 In. cylinder, used.
600—WESTINGHOUSE & LELAND GI MOTORS, GOV'T RATING .6 HP, 3 ph, 50/60 Cy, 945/1145 RPM 115/130 Volt. Totally enclosed, BALL BEARING, many of these are installed on 1½ HP 3/60/220 volt circuits, as is and pulling up to 1½ HP loads.
1—200 KW WESTINGHOUSE ALTERNATOR, damper wdg. 3/60/2200, 600 RPM, bltd exc, used.
1—1000 KVA, 257 RPM, sgl brg. ATB, 3/60/2400, dir. exc, ALTERNATOR, VERY LITTLE USAGE.
1—1250 KVA, 3/60/3600/440 GE TURBO-GENERATOR SET, 2 stg. bleeder type GE turbin 150 LB. pressure, CI base, dead front self. con. switchboard, 4 panels, with Volt. reg., etc.
3—500 HP, B & W STERLING BOILERS, 160 lb. design with Worthington-Moore turbin feed water pumps and 50 HP Worthington Elec. pump, 3-cope feed regulators, governors, and 9—Pan American fuel oil burners.
2—B & W Waste Heat boilers 2000 to 700 de. F, 20,800 CFM, 155 Lb. steam del. Pres.
1—EVAPORATING & CRYSTALIZING PLANT, Swensen Calandria type, and Vacuum crystallizer, 2 stage, with condensers, vacuum equipment, liquor piping, pumps, bodies with manometers, gauges, testers, agitators, etc. Write for full particulars and description.
1—5 x 5 ft. Colorado BALL MILL WITH ELECTRIC MOTOR, CONTROLS AND DORR CLASSIFIER, USED.
1—10' x 36" HARDINGE CONICAL BALL-MILL with 300 HP, 3/60/2200, High Torque, 164 RPM, GE, SYNCH MOTOR AND CR7065-651 GE CONTROL, MILL HAS TITANITE staggered liners, chute feed, air classifier for dry grdg, grates, with #128 LOOP classifier and finished product collector, 10 KW MG set, etc., used and good.

INQUIRE FOR COMPLETE DESCRIPTION AND PRICES OF ABOVE EQUIPMENT

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(NEW) HEAT CONTROL AND RECORDERS

3 Wheelco Capacilogs—Model 702

1—Range 0—600 C. Degrees.
1—Range 0—1200 C. Degrees.
1—Range 0—1600 C. Degrees.

New in original crates

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TURBINE UNITS

1—15830 KVA G.E. Cond. 60 cy. 13200 V. 275-lb.
1—10000 KVA G.E. Cond. 25 cy. 6600 V. 200-lb.
1— 6250 KVA Allis Cond. 60 cy. 4800 V. 175-200 lb.
1— 5000 KVA West. Cond. Extr. 60 cy. 480 V. 385 lb.
1— 3750 KVA G.E. Cond. 60 cy. 2300 V. 185-lb.
1— 2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lb. 40-lb. BP
1— 2500 KVA G.E. Extr. Cond. 60 cy. 480 V. 185-200 lb. Steel Valve Chest
1— 2500 KVA G.E. Cond. 60 cy. 600 V. 175-lb.
2— 2250 KVA G.E. Cond. 60 cy. 240-480 lb.
1— 1875 KVA West. Cond. 60 cy. 2300 V. 170-lb.
1— 1875 KVA G.E. Cond. 60 cy. 2300 V. 180-lb.
1— 1563 KVA G.E. Extr. Cond. 60 cy. 2300 V. 200-lb.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
1— 938 KVA G.E. Extr. Cond. 60 cy. 240 V. 200-lb.
1— 938 KVA West. Extr. Cond. 60 cy. 2300/4100 V. 200-lb.
1— 750 KVA G.E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.
2— 250 KVA Elliott Non-C. 60 cy. 208 V. 200-lb. 5-lb. BP

DIESEL ENGINE UNITS

2—1700 HP Gen. Motors 2300 V. 60 cy.
1—1600 HP Fair. Morse 2300/4150 V. 60 cy.
1— 600 HP Enterprise 440 V. 60 cy.
2— 500 HP Winton 2400 V. 60 cy.
1— 250 HP Buckeye 240 V. 60 cy.

STEAM ENGINE UNITS

1—625 KVA Ames Vertical Uniflow 2300 V.
1—250 KVA Ames Vertical Uniflow 480 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

ROTARIES — 60 CY.

QU.	KW	MFR.	VOLTS-DC	TRANS.	RPM
1	3250	G.E.	225/235	13800	300
1	1500	G.E.	600	4150	600
3	1000	G.E.	600	13200	900 Auto.

SYNCHRONOUS CONDENSERS

QU.	KVA	MFR.	VOLTAGE	RPM
1	7500	G.E.	13800	720
1	2500	West.	2400/4160	900
1	2000	West.	2300	720
1	1500	G.E.	4800	900
1	1500	West.	2300	900

COMPLETE DIESEL PLANT

2—1250 KVA General Electric, 3/60/2300 V. 720 RPM generators coupled to General Motors 1700 HP Diesel engines. Complete with all auxiliaries. Still on foundation.

MERCURY ARC RECTIFIERS

QU.	KW	KIND	DC VOLTS	TRANS.
2	4500	Multi Anode	600	13800
1	1000	Multi Anode	600	13800

MOTOR GENERATOR SETS — 60 CY.

QU.	KW	MFR.	VOLTS-DC	A.C.	RPM
1	2000	G.E.	600	4000	450
1	1500	G.E.	600	4150	600
2	1000	West.	600	4150	900
1	500	West.	125	2300	720
1	200	West.	275	2200	900
2	150	G.E.	250	2300	1200
1	150	West.	275	440	900
1	75	West.	125	440	1200

SYNCHRONOUS MOTORS — 60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
2	700	West.	2300	200
1	600	G.E.	2300	1800
1	800	G.E.	440	380
1	500	G.E.	2300	600
1	300	West.	2300	900
1	250	Cr. Wh.	440	300
1	115	West.	440	1200

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	5000	G.E.	25/60	300
1	3125	G.E.	25/60	360
1	3000	G.E.	60/25	300
1	2500	G.E.	25/62½	750
1	1700	West.	60/24	720
1	1250	G.E.	25/60	300

TRANSFORMERS

3— 3333 KVA West. 132000—7620/13200 Y
3— 75 KVA A.C. 66000/24000—7200/12470 Y
1— 2500 KVA G.E. 69/73 KV—5 taps. 3 ph.
4— 2500 KVA West. 44000—11000
4— 1000 KVA West. 44000—11000
3— 100 KVA Wag. 44000—7200
3— 100 KVA G.E. 44000—2300
3— 75 KVA West. 44000—7200/12470 Y
3— 8333 KVA West. 43800—13800
3— 100 KVA Wag. 36000—7200/12470 Y
1—18750 KVA A.B.B. 34840—11000, 3 ph.
3— 150 KVA Wag. 33000—7200/12470 Y
3— 100 KVA A.C. 33000—7200/12470 Y
3— 100 KVA West. 33000—240/480 NEW
3— 75 KVA Wag. 33000—7200/12470 Y
3— 50 KVA G.E. 33000—2300
4— 450 KVA A.C. 25410/44000—13200/23000
3— 800 KVA G.E. 22000—2300
3— 100 KVA G.E. 22000—7200/12470 Y
9— 50 KVA G.E. 2200—2300
4— 750 KVA Wag. 19050/33000 Y—6900/11950
3— 600 KVA G.E. 13800/6900—480
3— 480 KVA G.E. 13800/6900—480
6— 200 KVA G.E. 13200—2300
3— 200 KVA G.E. 11500—220/110
3— 200 KVA Mal. 11000—2300
3— 100 KVA West. 7200/12470 Y—2400
4— 50 KVA G.E. 7200/12470 Y—2300
3— 500 KVA Pitts. 6900/11900—550
3— 333 KVA Pitts. 6900/11900—550
3— 150 KVA Wag. 6900—2300
4— 100 KVA G.E. 6900/11900—2400
3— 37½ KVA G.E. 6900/11900—2400
1— 100 KVA G.E. 2300—575, 3 ph.
6— 50 KVA West. 2400—115/230 DRY TYPE
3— 15 KVA Stand. 450/225—117

OIL CIRCUIT BREAKERS

1—600 A. 73 KV G.E. FHKO-236-500 Outdoor
1—400 A. 37 KV G.E. FHKO-138-350 Outdoor
1—400 A. 37 KV G.E. FHKO-236-500 Outdoor
4—600 A. 15 KV G.E. FHKO-138-750 Outdoor
2—600 A. 15 KV G.E. FHKO-136-1328BS Outdoor
1—1200 A. 15 KV G.E. FKO-139-350 Outdoor
1—600 A. 15 KV G.E. FKO-138-350 Outdoor

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220/440 V PRIMARY 110/220 V SECONDARY				550 V PRIMARY 110/220 V SECONDARY	
26— 1	KVA	5— 7½	KVA	5— 1	KVA
12— 1½	KVA	4—10	KVA	5— 1½	KVA
63— 2	KVA	5—15	KVA	73— 2	KVA
4— 3	KVA	3—25	KVA	6— 3	KVA
9— 5	KVA			4— 5	KVA
				9— 7½	KVA
				7—10	KVA
				12—15	KVA
				3—25	KVA
				3—37½	KVA

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TRANSFORMERS—60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1500	Whse.	Hiperail	3	66000/33000 pri., 240/480 sec. w/Taps
1	1500	GE	Pyranol	3	4150x2300Y
1	500	Kuhl.	OISC	1	4600x2300Y
1	300	Pitts.	OISC	1	7800x440Y
1	200	GE	HT	3	2300x230
1	200	Whse.	Auto	3/3	4150x2300
1	200	Pitts.	OISC	1	4600x110/220
1	200	GE	Auto	3/3	4150x2400
1	108	Pitts.		1	2750x110/220
3	100	Wagner	RCKV	1	240x120/120
6	50	GE	H	1	13,750x125/216Y
2	37½	A. Ch.	AD	1	450x120
2	25	G.E.	H	1	11,500x230/460

SPECIAL—WELDING MOTOR GENERATOR SET

1—174 KVA Whse. Welding Gen. Set, 1 Ph. 28V, 860 Amp 87% PF with Slip Ring Motor & Exciter

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED	DC	AC
1	1000	GE	514	600	2300/4150 Syn.
1	300	GE	1200	250	2300 Syn.
1	200	Whse	900	250	220/440 Syn.
1	150	GE	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	El. Mach.	1200	125	4150 Syn.
1	100	GE	900	250	2300 Syn.
1	94	GE	1200	60	440 SC
3	94	GE	1200	60	4150 Syn.
1	75	Cr. Wh.	1200	250	4150/2300 syn.
2	40	El. Mach.	1750	125	440 SC

SYNCHRONOUS

300 HP El. Mach. 720 RPM 2300 V T.E.F.C. outdoor Service

200/100 HP Whse. 720/360 RPM 4150 V.

SLIP RING

1	2500	GE	Mf	6600	257
1	250	Whse.	CW	440	600
1	200	GE	MT	2300	1800
1	200	Whse.	CW	440	600
1	200	GE	MT	440	600
1	100	GE	TM	440	600
1	75	GE	MT	220	1200 Vert
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1300

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2000 K.W., 3 ph., 60 cy., 150 lbs G.E.
1000 K.W., 3 ph., 60 cy., 250 lbs G.E.
750 K.W., 3 ph., 60 cy., 200 lbs extract. G.E.
500 K.W., 3 ph., 60 cy., 150 lbs G.E.
150 K.W., 250 v. new Westgh., D.C.

DIESEL UNITS

62½ KVA., 3-60-220-440 v., Caterpillar
37½ KVA., 3-60-220 v., Ready Power
100 K.W., 250 v., D.C. Superior Delco

UNUSED PUMPS & MOTORS

Union Steam Co., pumps all 250 ft. head with new Louis Allis motors, 1750 rpm.
1—490 GPM, 50 HP motor
1—580 GPM, 75 HP motor
1—990 GPM, 100 HP motor

TRANSFORMERS

1—600 KVA., 3 ph., 13800 x 575
1—500 KVA., 3 ph., 11500 x 460
2—500 KVA., 13800 x 2300
7—100 KVA., Gen. Elec. 11000 x 2200 v.
3—100 KVA., Maloney 11400 x 2200 v.
4— 50 KVA., Gen. Elec. 11000 x 2300 v.
2— 50 KVA., Westgh. 13800 x 230—460 v.
100—Transformers late type pocket bushings 12000-11500 x 120-240

3 PH., MOTORS

425 HP., Gen. Elec. MT414Y, 392 rpm., Slip rg.
300 HP., Gen. Elec. 257 rpm., syn.
200 HP., Gen. Elec. IM,—585 rpm., Slip rg
200 HP., Westgh. CW., 1750 rpm., Slip rg.
200 HP., Gen. Elec. IM., 435 rpm., Slip rg.
200 HP., Gen. Elec. KT339, 1150 rpm., Sq. cage
150 HP., Gen. Elec. IM., 1800 rpm., Slip rg.
150 HP., Gen. Elec. IM., 514 rpm., Slip rg.
100 HP., Gen. Elec. IM—570 rpm., Slip rg.
100 HP., Gen. Elec. IM—585 rpm.
100 HP., Westgh., 900 rpm., Syn
100 HP., Gen. Elec. KT345, 1800 rpm., Sq. cage
100 HP., Elec. Mchy, 300 rpm., syn.

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2—400 amp., 3 pole 15000 volts FO24 Westgh. electrically operated breakers disconnects etc.

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3—833 KVA Westinghouse transformers OISC, 1 ph., 2400/4160Y to 480 volt, Type SL, Ser. 2-150,000
1—200 HP, 600 RPM, GE, Slipring IM, Frame 17, 3/60/220/440
1—150 HP, 514 RPM, Westinghouse Slip-ring, Type HF, 3/60/220/440
1—200 HP, 600 RPM, EM, Synchronous 3/60/2200 type BRKT
1—125 HP, 600 RPM, EM, Synchronous 3/60/2200 type BRKT
1—200 KW MG set, 125 V. DC, 900 RPM Synchronous drive, 3/60/2300 E.C. Factory Set.
2—24x24 Dayton Dowd CS24, 16,500 GPM, 18.5/35 FT. HD., 360/450 RPM

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600 Amp., WEST. Outdoor Breaker

50 KV. 300,000 KVA, Int. Cap. 125 V. DC, Sol. Oper. $2,250.00

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2000 & 1400 Sq. Ft. Surface Condensers
200 & 100 KW Gens. D/C N.R.C. Engines
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"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
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SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
400	G.E.	I-M	1200	S. B.
300	G.E.	I-M	1200	S. B.
200	G.E.	I-M	1200	S. B.
150	G.E.	I-M	1200	S. B.
150	G.E.	I-M	1800	S. B.
100	G.E.	MT-300	1800	S. B.
100	G.E.	I-M	900	S. B.
100	G.E.	I-M	720	S. B.
75	G.E.	MT-343	1200	S. B.
75	G.E.	I-M	900	S. B.
75	West.	CW	720	S. B.
75	G.E.	I-M	720	S. B.
60	G.E.	MT-333	1800	S. B.
40	G.E.	I-M	1800	S. B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
150	G.E.	K-6328	3600	TEFCBB
150	G.E.	K-6328	1800	TEFCBB
125	G.E.	K-6328	1200	TEFCBB
100	West.	CS-5078	1800	TEFCBB
100	West.	CS-504	1800	B. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBB used
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	B. B. open
75	F.M.	QS-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	CS-504S	1800	TEFCBBXP
60	G.E.	K-584S	1800	TEFCBBXP
60	L.A.	6G-44	1800	B. B. open
60	F.M.	QS-444	1800	B. B. open
50	Master	FB-404	3600	TEFCBBXP
50	G.E.	K-445	1800	TEFCBB
50	G.E.	K-405	1800	S. B. drip
50	West.	CS-445	1200	S. B. open
50	G.E.	K-505	900	TEFCBBXP
40	A.C.	AR-444	3600	TEFCBBXP
40	G.E.	KF-365S	3600	B. B. splash
40	West.	CS-405	1800	TEFCBB
40	L.A.	K-405	1800	TEFCBBXP
40	G.E.	404	1800	B. B. open
40	Cr. Wh.	BC-445	1200	TEFCBB
30	G.E.	KF-365S	3600	B. B. splash
30	West.	CS-365B	3600	S. B. splash
25	Line.-Weld	DBD-328	3600	S. B. open
25	West.	CS-364	1800	S. B. splash
25	G.E.	K-364	1800	S. B. drip
20	G.E.	K-364	1800	S. B. drip
20	L.A.	EX-364	1800	TEFCBBXP
20	G.E.	KF-404	1200	TEFCBBXP
20	G.E.	KG-405	900	TEFCBBXP
20	G.E.	KF-405	900	TEFCBBXP
15	L.A.	EX-326	1800	TEFCBBXP
10	West.	CS-2942	3600	TEFCBB
10	Howell	EKBB-28-51800		TEFCBBXP
10	Reliance	AA-CB-324	1800	TEFCBB
10	West.	CS-324	1800	TEFCBB
10	West.	CS-324	1800	B. B. open
10	L.A.	EX-328	1200	TEFCBBXP
10	G.E.	K-364	900	S. B. drip
10	L.A.	R-1838	600	TEFCBB
3	G.E.	K-224	3600	TEFCBBXP
3	L.A.	EX-225	1800	TEFCBBXP

SQUIRREL CAGE MOTORS REBUILT

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	MAKE	TYPE	SPEED	DESCRIPTION
200	Wagner	RP-2-28	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-504	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S. B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S. B.
75	West.	CS-WL-807	1200	S. S. B.
75	G.E.	KT-552	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-333	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	25H	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.
50	G.E.	KT-312	900	S. B.
50	G.E.	KT-346	900	S. B.
40	G.E.	K-444	1800	S. B.
40	G.E.	KT-323	1800	S. B.
40	West.	CS	1200	S. B.
40	G.E.	KT-336	900	S. B.
40	F.M.	B-H12D	900	S. B.
40	G.E.	KT-542	720	S. B.
35	Triumph	B-12	900	S. B.
35	G.E.	I-L	900	S. B.
35	G.E.	I-K	720	S. B.
30	G.E.	KT-312	1800	S. B.
30	West.	CS	1200	S. B.
30	G.E.	KT-332	900	S. B.
25	G.E.	KT-312	1800	S. B.
25	West.	CS-471	1800	S. B.
25	Century	SC-30	1200	S. B.
25	G.E.	I-K	720	S. B.
25	F.M.	B-H12-B	720	B. B.
20	West.	CS-384	1800	S. S. B. splash

We have in stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM.
We also carry in stock a large quantity of used electric motors from 1 HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER EQUIPMENT COMPANY

8 CAIRN STREET — P. O. BOX 534 — ROCHESTER 2, N. Y.
Telephone: Genesee 5629

COMPRESSORS AIR or GAS

GUARANTEED REBUILT

All Types and Sizes

Motor and Steam Drive

Also:—Aftercoolers, Air Receivers, V-Belt Drives.

EARL E. KNOX CO.
1107 BACON ST. ERIE, PENNA.

BOILERS

10 to 5000 H.P.

Diesel, Steam Turbine, Engine

GENERATORS

Heavy Power Equipment
Industrial — Chemical Process Equipment

NEW – RECONDITIONED – USED

DEAN G. STRICKLER & ASSOCIATES
1346 Connecticut Avenue, N.W.
Washington 6, D. C. • DuPont 3388

375 KVA - FOR SALE - 300 KW

WORTHINGTON-WESTINGHOUSE INSTALLATION

COMMERCIALLY UNUSED

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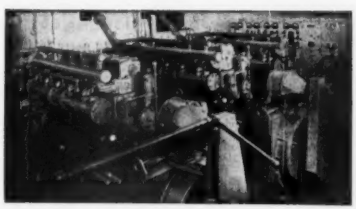
IMMEDIATE DELIVERY



Each Plant consists of

3 Worthington Model BB 5—150 HP Diesel Engine Generating Units direct connected to Westinghouse Generators.

Rated 100 KW—125 KVA—3 phase, 60 cycle, 460 Volts, AC Current at 600 RPM.

Suitable for reconnection to 85 KW—3/50/230/400 at 500 RPM.

Complete with all accessories and auxiliaries including evaporative coolers—switchboard—distribution panel.

OWNED & OFFERED BY

KANE-McGUIRE COMPANY

Single units available

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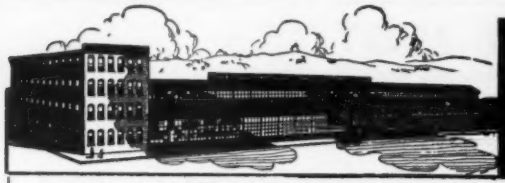
Brooklyn, New York
PHONE: WHitehall 3-6843



GLOW ELECTRIC CO.

927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

MEMBERS OF AMERICAN REBUILDING ASSOCIATION, A MEMBER BODY OF AMERICAN STANDARDS ASSOCIATION

SQUIRREL CAGE, OPEN 3 PHASE MOTORS

HP	RPM	VOLTS	DESCRIPTION
750	900	2600	Westinghouse
350	3600	2200	Westinghouse
300	900	440	G.E.
125	3600	220/440	A-C
125	1800	2200	A-C
115	1200	440	G.E.
100	1800	2200	Westinghouse
100*	1200	2200	G.E.-KF544
100	720	440	Westgh. 3 Brg.
85	3600	2300	G.E.
60	3600	2200	G.E.
60	1800	2200	G.E.
60	1200	440	Westgh. CS
50	1800	220	Triumph
50	720	2200	Westinghouse
40	900	440	G.E.
40	720	440	G.E.
35	3600	220	G.E.-KT
35	600	440	G.E.
30	720	220	G.E.
30	514	440	Stanley
25	3600	220/440	L-A
25	1800	220	L-A-HD
25	1200	220	Century
25	900	440	G.E.
25	720	220	Westinghouse
25	600	440	G.E.
20	3600	440	A-C
20	1800	220/440	G.E.
20*	1800	220/440	Wesche
20	1200	440	A-C
20	900	440	A-C
20	600	220	G.E.
15	3600	220	G.E.
15	1800	220/440	G.E.
15	1200	220	Imperial
15	900	220	Howell
15	720	220/440	A-C
10	3600	220	R. & M.
10	1800	220	Westinghouse
10	1200	220	A-C
10	900	220	A-C
10	720	440	A-C

* New Motors

SPECIAL

NEW DIESEL

Murphy ME650—165 HP, 1200 RPM 6 cylinder, 5¾ bore, 6½ stroke, complete. Will furnish engine only or as AC or DC Engine-Generator Set.

SLIP RING MOTORS

HP	RPM	VOLTS	DESCRIPTION
300	1200	440	Westgh.-CW
300	720	2200	Al. Ch.
250	600	2200	G.E.-117B
250	300	2200	Al. Ch.
200	1800	440	Al. Ch.
150	1800	440	G.E.-MT
138	720	2200	Al. Ch.
125	900	550	Ideal
100	720	440	Al. Ch.
100	600	440	West. Elec. (GE)
75	600	440	Al. Ch.
75	360	550	G.E.
60	1800	220/440	Al. Ch.
60	900	2300	Burke
50	1200	220	F-M
50	900	2300	Ridgeway
50	720	440	Al. Ch.
43	1200	440	Westgh.
40	900	220	Al. Ch.

MOTOR GENERATOR SETS

D.C. OUTPUT KW	Voltage	Description	A.C. INPUT HP	RPM	Volts
750	500	Westgh.	1070	900	13200
600	250	Westgh.			
		(2-300KW Gen.)	1200	1200	2300
400	250	Westgh.-G.E.	600	1200	220/440
300	250	G.E.	450	1200	2300
200	125	G.E.-Westgh.	300	720	2300
200	125	G.E. (25 cy.)	300	730	440
200	250	G.E.-Westgh.	300	1200	440
100	250	Westgh.	147	1200	4000
75	125	G.E.	115	1200	440
50	125	C-W	85	1800	440
47½	125	Al. Ch.	100	1200	2300
40	250	Westgh.-G.E.	60	1200	220/440
22	125	Al. Ch.	33½	900	220
20	115	G.E.-Al. Ch.	30	900	220
15	250	Al. Ch.-L.A.	25	1800	220/440
12½	230	Westgh.	19½	1800	220
10	250	Westgh.	15	1800	220/440
7½	125	Westgh.	10	1200	220
5	230	Westgh.	7½	1200	440
3	250	Reliance-G.E.	5	1800	220
1	115	G.E.	1½	1800	220/440

PLATING AND ANODIZING SETS

D.C. OUTPUT AMPS	VOLTS	RPM	DESCR.	A.C. END HP	VOLTS	DESCR.
7500/3750	6/12	270	Munning	80	440	West. CS Sq. Cage
4000	2 to 8	425	Jantz & Leist			
2400	40/80	1200	Westgh.	290	448	WH Sync.
1500	3 to 40	600				
1500/750	6/12	1200	Munning Loeb	15	440	GE—1 Cage
1000		90	1200	Century	100	440	Century Cage
1000		20	1200	Star. 1 Brg.	—	—	—
1000		6	1200	Wagner	—	—	—
660		11	900	Westgh.	15	440	W.H. BB.
600		50	900	E-M	40	440	A-C
600		30	1250	W-E	30	440	GE
600		20	900	G.E.	25	440	GE
500		40	1200	G.E.	30	440	GE-KT
500		12	1200	Ideal	10	220	GE-KT
500		6	GE	Rectifier	—	440	—
416		12	1200	HVW	7½	440	GE-KT
400		40	1800	Hobart	25	220/440	Hobart
208		62	1800	G.E.	20	220/440	GE-KT

M.G. SETS & CONVERTERS

KW	MAKE	RPM	D.C.	A.C.
750	Al. Ch.	720	250	2300
500	West. Rotary	1200	250	2300
400	West.	720	250	2300
300	GE	1200	250	2300
300	GE Rotary	600	250	2300
300	West.	1200	250	2300
300 (2)	Al. Ch. Rotary	1200	250	2300
300	West.	1200	550	2300
200	G.E.	1200	250	2300
150	GE	900	550	2300
150	West.	1200	250	2300
100	Rids.	1200	250	2300
50	G.E.	1200	250	2300

A.C. MOTORS

HP	MAKE	RPM	TYPE
400	GE	450	Sl.Rg.
300	GE	450	Sl.Rg.
150	GE	900	Syn.
100	West.	900	Syn.
100	West.	1200	Sq.Cg.
100 (2)	GE	1750	Sq.Cg.
100 (2)	GE	450	Sl.Rg.
75	West.	900	Sq.Cg.
60	West.	880	Sl.Rg.
50	GE	1750	Sq.Cg.
40	GE	900	Sl.Rg.
40	West.	900	Sq.Cg.
30	G.E.	900	Sq.Cg.
30	G.E.	1200	Sq.Cg.

PLATING M-G SETS

3—1500/3000 Amp. 6/12 Volts—AC Syn Motors
1—1500/3000 Amp. 6/12 Volts—AC Sq.C. Motor
1—1000 Amp. 75 volt 75 KW—AC Sq.C. Motor

AIR COMPRESSORS

350 CFM Chg. Ph. 12"x10" NSB 100#.
142 CFM Ingersoll Rand 25-B. Late type. Portable.

MOORHEAD ELECTRICAL MACHINERY COMPANY

361 Noblestown Road (Est. 1919) Oakdale, Penna. Pittsburgh District

TWO DETROIT UNDERFEED UNISTOKERS

Suitable for boiler furnace widths 7 ft., 7'-6" or 8 ft., length 7'-6" capacity up to 375 boiler H.P. continuous and 500 H.P. peak loads with 13,500 BTU coal, driven by 16A Carling turbines designed for 125 lbs. steam pressure. Motor drive can be applied to develop up to 360 boiler H.P.

Priced for quick sale at $500.00 each

H. J. McGRATH CO.

2501 Boston St. Baltimore 24, Md.

SPECIAL OFFERING — Immediate Delivery

2—D. M. Dillon Scotch Marine Boilers, 165# pressure, A.S.M.E., N. Y. Standard, Oil Fired, further specifications on request.

6—870 H.P. Babcock & Wilcox Boilers—Cross Drum, Sectional Headers, straight tubes—Built for 290# were insured and operating at 209# up to March First. Full particulars given upon request.

1—283 H.P. Babcock & Wilcox Boiler—Cross Drum, Sectional Headers, straight tubes—Built for 225#, installed 1937.—This boiler has a Fusion Welded Drum, 70,000#.

1—New & Unused AMESTEAM GENERATOR—size A-250—250 H.P. at 150# for #3 oil or natural gas firing. Complete with accessories.

1—Combustion Engineering, Low Head Boiler, 400 H.P. at 185#, built 1943, complete with Stoker, Forced and Induced Draft Fans, Stub Stack and other accessories. Used very little.

We handle Boilers of various sizes and varying pressures; also Turbo-Generators, Diesels, transformers, switchgear, compressors etc.

We buy entire power plants. What have you to offer?

HOWE BROTHERS

342 MADISON AVENUE MUrray Hill 2-8562 NEW YORK 17, N. Y.

TURBO UNITS

2—7500 KW (9375 KVA) G. E. Condensing Turbo Units, 175 PSI, 6600 Volts, 3 phase, 60 cycle.
Complete—Excellent Condition.

TRANSFORMERS

6—150 KVA Packard, Single Phase, 2400/4160—240/480 Volts. *Rebuilt.*
2—100 KVA Packard, Single Phase, 2400/4160—240/480 Volts. *Rebuilt.*
3—75 KVA G. E., Single Phase, 7200/4160—Volts. *Rebuilt.*

TIPPINS MACHINERY CO.

1001 WASHINGTON BLVD.
PITTSBURGH 6, PA.

750 KW, GE MG SET

ATI-MCF, 3/60/2300-4000 X 575 V. 720 RPM, 70% PF, 3 Bear. Factory Set. Automatic AC, & DC. Controls. $10,000.00

S. M. DAVIS

510 LASALLE ST. ST. LOUIS 4, MO.

FOR SALE

Quantity of Model SGV-700C-11

FAIRCHILD AIRCRAFT ENGINES

12 Cylinder—Inverted Vee-Type—Air Cooled—Geared Drive.

FS-3511, POWER

330 W. 42 St., New York 36, N. Y.

DIESEL AND GENERATOR

215-hp Venn-Severin Model H, 2-cycle, 327 rpm Air Comp. & Tanks, Heat Exchanger, etc.
150 KVA Ideal Elec. Flywheel-type Generator, 3/60/240/480 V. with 7½ KVA Exciter, Western Electric Control Panel, etc.
Excellent condition, less than 18,000 hours.

LEDBETTER MANUFACTURING COMPANY
ROCKINGHAM, N. C.

REBUILT POWER EQUIPMENT—READY TO SHIP!

IMMEDIATE DELIVERY
AIR COMPRESSOR

876 cfm Chicago Pneumatic 100 lb. pressure 2300 or 440 v, A.C. syn. motor complete with starting equipment.

A.C. MOTORS
220/440 volt 3 ph. 60 cycle

HP	MAKE	RPM	TYPE
1000	Elec. Mach.	1200	Syn.
535	Elliott	720	Syn.
450	Elliott	720	Syn.
400	Westg.	600	CS
350	Westg.	585	CS
300	G.E.	1800	KT-563
250	G.E.	515	KF-TEFC
250	Burke	720	2300 v. Syn.
250	G.E.	1150	I
235	Elec. Mach.	1800	Syn.
200	G.E.	440	KF-TEFC
200	Westg.	291	(2200 v.) CS
200	G.E.	860	I
200	G.E.	1800	(2200 v.) Syn.
200 (2)	Wagner	1750	RP-2
200	Westg.	1750	CS-871C
150	G.E.	400	2200 or 220 v.
150	Cr. Wh.	860	QB
150	G.E.	1200	KT-563
150	G.E.	1200	4100 or 2200 v.
150 Vert.	G.E.	1775	KP-2200 v.
150	G.E.	1775	KF-6542
125	Elec. Mach.	164	Syn.
125	Cr. Wh.	720	
100	Cr. Wh.	600	
100 (2)	Westg.	1750	CS-663
100 New	Reliance	1765	B-50848 BB

SLIP RING MOTORS
3 Phase — 60 Cycle

HP	MAKE	RPM	TYPE
60	G.E.	570	MTC-5346
75	G.E.	720	I-M
75	G.E.	600	I-M
75/150	Westg.	290/580	CW-1012
150	Westg.	1140	CW-873C
150	G.E.	600	I-M-16
200	Westg.	580	CW-1000
300	Cr. Wh.	290	(2200 volts)
400	Westinghouse	580	CW-39B (2200 volts)
400	Westg.	438	(2200 volts) 220/440
450	Allis Chal.	293	(2200 volts)

FOR SALE or RENT
SPECIAL BARGAINS
DIESEL ENGINE GENERATOR SETS

4—100 KW., 120/240 V. D.C. Delco Generators dir. con. to 150 HP., Model GBD-3, 5½ x 7, 8 cyl., Superior Diesel Engines, elec. start, power panel, accessories. Practically new—only used for spares.

3—100 KW., 220/440 V. A.C. 3 ph. 60 cy. West. Gen. dir. con. to 150 HP. Superior Diesels same as above.

1—96 kva. Fairbanks Morse 220/440 V. 3 ph. 60 cy., 360 rpm DIESEL.

10—37½ kva. 3 ph. 60 cy. 127/220 v. or 220/440 v. 1200 rpm., Century A. C. Generators with dir con. exciters driven by 70 HP., 4 cyl. Model UD-14 International Harvester DIESEL Engines with panels.

2—25 kva. 120 v. 1 ph. 60 cy. Westinghouse dir. con. to 58 HP., 4 cyl. 900 rpm., LeRoi Gasoline Engines with control panels.

3—25 kw., 220/440 v. 3 ph. 60 cy. Westinghouse direct connected to 4 cyl. LeRoi Gasoline valve in head liquid cooled Engine complete with control panels.

17-7½ kw., 120 v. 1 ph. 60 cy. Continental Gas Engines.

25 CYCLE MOTORS
220/440 v. 3 ph.

HP	MAKE	RPM	TYPE
150	G.E.	730	KT-563—2200 v.
125	Reliance	1450	AA-A685Z—BB
75	Westg.	400	M8—Hi-Torque
75	Westg.	475	CW-873C—Slipring
50	Westg.	715	CS
40	G.E.	1455	KT-337
35	Wagner	500	BP
30	Westg.	725	CS-W504 SP BB

25 CYCLE MOTORS (Cont.)
220/440 v. 3 ph.

HP	MAKE	RPM	TYPE
30	Reliance	1440	AA-445Z TE FC BB
20	Reliance	445	AA-C504 TE FC BB
20	Imperial	680	Frame 404 TE NV BB
20	Star	695	AHS-68 BB—Slipring
20	Reliance	1450	AA-B405 TE FC BB
15	Westg.	400	CS-364Y
15	Westg.	583	Frame 364Y
15	Reliance	710	AA-B-404 TE FC BB
15	G.E.	720	K-405 TE FC BB
15	Reliance	1450	Frame 74AA BB
15	Reliance	1450	Frame 119-AA FC BB

DC VARIABLE SPEED MOTORS
230 Volts

HP	MAKE	RPM	TYPE
400	All. Chal.	400/1200	
250	G.E.	500/1000	CDM-1650Y SPBB
125	Westg.	125/500	BB Anti-Fric.
100	Westg.	500/1000	SP BB
75/150	G.E.	300/1200	CD-189 BB Encl.
75/100	Westg.	600/1200	SA-13L SB
50	G.E.	600/1200	LC
50	Reliance	400/1600	T-985F TEFC BB
50	Reliance	300/1200	T1985T BB
50	Crkr. Whlr.	300/1200	CMC-8B
40/50	Westg.	500/1500	SK-131 SP BB
40/50	Reliance	500/1500	T-461T BB
40	Westg.	750/1500	SK-140
40	Al. Chal.	575/1150	E-145
40	Reliance	500/1500	T-461F TEFC BB
40	Reliance	400/1600	T-615F TEFC BB
40	El. Gen. Co.	385/1200	Frame 180S
35	G.E.	625/2100	CDM-1829AE
35	G.E.	350/1400	RF-162 SS
30/40	Imperial	400/1600	D-D69 BB DP
30/40	Reliance	300/1200	T-651 TE BB
30	Westg.	1150/1750	SK-133 TEFC BB
30	Reliance	600/1200	T-262F TENV BB
30	Reliance	400/1600	T-461F TEFC BB
30	Imperial	400/1600	D-D69 BB DP
25	Reliance	400/1600	T-310F TEFC BB
25	G.E.	300/1200	CD-123
20/25	Reliance	400/1600	T-262T DPBB
20	Westg.	750/1500	SK-110-L
20	Westg.	625/1250	SA-8
20	Reliance	600/1200	T-131T BB
20	Westg.	565/1130	S-8
20	G.E.	500/1500	RF-11 SB
20	Reliance	400/1600	T-262T TEFC BB

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

DIESEL ELECTRIC PLANT

520 HP, FM Mod. 31-A 8½-AC, 514 RPM, 412 KA, FM, Type TGZJ, 3/60/2400, Generator. Switchboard and complete plant auxiliaries. New 1948, Used less than 2000 hours. Can demonstrate on foundation.

DELL STEPHENSON & COMPANY
14456 Glastonbury
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SAVE ON REPLACEMENT COST
NEW ROTATING ELEMENTS FOR IR-CAMERON PUMP
1—8" LFV Imp Dia. 12". 1—6" ALV Imp Dia. 17".
1—5" ALV Imp Dia. 16". 2—6" ALV Imp Dia. 17".
EVERYTHING IN NEW AND USED PUMPS
C-B EQUIPMENT AND PUMP COMPANY
6805 Easton Ave., St. Louis 14, Mo. Fireside 2098

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Various Models in Stock
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Used Equipment—Good Condition
Inspection Invited

EVAPORATING & CRYSTALLIZING PLANT—7 Swenson Calandria type Evaporators and one Vacuum Crystallizer, two stage. Complete plant with pumps, etc., on steel structure.

POWER PLANT—3—500 HP B & W Sterling type Boilers, complete aux. equip. Also 2 Waste Heat Boilers, same type. 1250 KVA 440 V. Generator direct connected G.E. Steam Turbine, switch board and aux. equip. Also steam driven C.P. Air Compressor size 12" x 14" x 11".

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MANGANESE, INC.
P.O. Box 2008 HENDERSON, NEV.

EXCELLENT POWER UNITS
2—125 KVA Westinghouse AC generators, 440 Volts, 277 RPM. Powered by 2 Bruce Mac Beth gas/gasoline engines.
1—150-HP, 225 RPM, Synchronous motor. Real Bargains.
A A A IRON CO.
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New and used equipment recently released from service by a number of electric and gas utility companies

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MOTORS • GENERATORS • TRANSFORMERS

7x7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

T.E.F.C. MOTORS

60 HP Westinghouse CS-607 3/60/440/900 X-Proof

50 HP Ideal New. 3/60/220/440/1800

2—20 HP Louis Allis ES. 365 3/60/220/440/1800 X-Proof

15 HP Louis Allis EX-364 3/60/220/440/1800 X-Proof.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheel 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy. 2400/4160 pri. 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

2—4000 KW, 2300 V., 150# Cond.
1—3500 KW, 4000 V., 150# Cond.
1—3000 KW, 4000 V., 150# Cond.
1—2500 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—2000 KW, 550 V., 175# Cond.
1—1500 KW, 2300 V., 200# Cond.
1—1250 KW, 2300 V., 250# Extr.
2—1250 KW, 2300 V., 225# Cond.
1—1000 KW, 2300 V., 175# Extr.
1—1000 KW, 2300 V., 250# Cond.
1—1000 KW, 4150 V., 280# N.C.
2—1000 KW, 480 V., 150# Cond.
1— 750 KW, 550 V., 170# Extr.
1— 500 KW, 2300 V., 185# Cond.
1— 300 KW, 2300 V., 150# Cond.

DIESEL GENERATORS

1—1000 KVA, 2400 V.
1— 700 KW, 480 V.
3— 540 KW, 480 V.
1— 437 KW, 480 V.
1— 200 KW, 480 V.

FIRE PUMP

1—New 1000 G.P. Turbine Driven

BOILERS

1—1,000 HP, 250#
2— 500 HP, 200#
1— 438 HP, 200#
2— 300 HP, 250#
2— 250 HP, 200#
4— 150 HP, 150# Se. Mr.
1— 78" H.R.T., 200#

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BOILERS

10 to 1000 H. P

NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
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MURRAY HILL 7-6547-8-9

94 KW CAT. DIESEL

2400/4160 volt, 3 phase, 60 cycle. Will reconnect for lower voltages. Switchboard voltage regulator and three 25 KVA-G.E. transformers—lot total $6000.00, top condition.

Oil circuit breakers, potentials, currents, power transformers, wire and cable, meters, motors, generators, M.G. sets, and other surplus.

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COMPRESSORS
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BEST BY TEST
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American Rebuilts Are Best

AMERICAN AIR COMPRESSOR CORP.
Doll Ave., & 47th North Bergen, N. J.

PUMPS—COMPRESSORS—BLOWERS

1—2000 GPM 350' Pump with 240 HP Turb.
1—750 GPM 231' Pump with 75 HP 3 ph. motor
2—675 GPM 428' Pumps with 125 HP Turb.
1—200 GPM 556' Pump with 50 HP 3 ph. motor
1—200 GPM 556' Pump with 50 HP Turb.
1—1100 GPM 220' AL.-Ch. Cent. Pump
4—2000-5000 GPM 32'-65', 10" & 12" Pumps
1—1000 GPM 280' all-bronze Cent. Pump
4—Kinney unused 6" Rotary Pumps
3—Blackmer 6" Rotary Pumps 500 GPM
3—750 & 1000 GPM Knowles Steam Pumps
1—8" x 10" & 1—7" x 10" Triplex Pumps
1—3" x 8" Galland Hydraulic Triplex Pump
1—8" x 10" Gardner Duplex Pump 300 GPM
1—12" x 14" Duplex Air Compressor 850 CFM
1—12" x 10" I-R Air Compressor 355 CFM
2—12" x 9" Worth. Comp. 375 CFM, Vac. & Press.
1—4-stage Norwalk Compressor 28 CFM 5000 PSI
1—Sturt. 60 H.P. Tur.-Blower 7000 CFM 20 oz.
1—GE 2-stage Turbo Blower 3000 CFM 16 PSI
1—Spencer 30 H.P. Tur. Blower 4000 CFM 16 oz.
1—60 H.P. DC 230 v. 1150 RPM comp. C-W Motor
1—50 H.P. DC 230 v. 1750 RPM ball.-bear Motor
10—Nash Vacuum Pumps and Vac.-Heating Units
250—Rebuilt Motors 1—200 H.P.
72—Exhaust Blowers, Fans, Unit Heaters
2—Kinney High-Vacuum Pumps, 100 C.F.M.

HUNDREDS OF OTHER ITEMS—ALL SIZES—ALL MAKES

SUPERIOR EQUIPMENT CO.

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MOTORS—M. G. SETS—TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1	400	Cont.	NZ-806	2300	1200
1	400	G.E.	1K	2200	514
1	400	G.E.	KT-412	2200	435
2	300	Whse.	CS-890	2300	1780
1	200	Whse.	CS-873C	2200	1160
1	200	Al.Ch.	AR	440/220	580
2	125	Al.Ch.	AR	2200	1750
1	125	Whse.	CS-761C	440/220	1750
1	125	C.W.	126-Q	440/220	430
2	100	Whse.	CS-663C	440/220	1750
1	100	Al.Ch.	AR	550	690
1	100	F.M.	H241B	440/220	435
1	100	Whse.	CS-938	2200	495
1	78	G.E.	I-K15	440/220	570
1	75	Al.Ch.	AR	2200	1765
1	75	Al.Ch.	AR	2200	1750
1	75	Al.Ch.	AR	2200	690

SYNCHRONOUS MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	PF	Volts	RPM
1	3000	Whse.	80	4800/2400	720
2	2100	G.E.	100	2300	360
3	1750	G.E.	100	2300	3600
1	750	G.E.	80	2300	450
1	187	G.E.	80	220/440	720
1	150	G.E.	100	2200	900
1	150	G.E.	100	550/2200	600
1	150	G.E.	80	550/2200	450
3	135	G.E.	80	4000/2200	1200
3	125	El.Mchy.	100	4800/2400	900
1	125	G.E.	80	2300	900
2	100	Whse.	80	440/220	1800
1	100	Whse.	100	2200	1200
1	100	Ideal	80	220/440	900
2	100	G.E.	80	220/440	600
1	60	G.E.	80	220/440	1200
2	50	G.E.	80	2300	600

SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1**	1200	C.W.	SR	2200	237
2**	1000	Al.Ch.	ANY	2200	235
1**	600	G.E.	MT-20	2200	260
2	500	G.E.	I-16-M	2300	450
1**	400	Al.Ch.	ANY	2200	514
2	400	G.E.	MT-412	2200	450
1	300	G.E.	I-16-M	2200	585
1	200	Al.Ch.	ANY	2200	514
1	200	G.E.	MT-414	2200	300
1	200	G.E.	I-16-M	2200	585
1	150	G.E.	I-13-M	2200	1750
1***	125	Whse.	CW-870	2200	870
1	100	F.M.	H20C	440/220	900
1	75	G.E.	4M	440/220	695
1	75	Whse.	CW-7540	440/220	690
1	60	Whse.	CW	440/220	900
1	50	G.E.	MT-536	2200	1150
1	50	F.M.	8R	440/220	600
1	40	Al.Ch.	ANY	2200/440	435

** Mill type pedestal bearing *** 3-Bearing

In our stock you will find manual and magnetic primary and secondary controls 10 to 3000 hp., which we can furnish complete for any requirements.

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
1	2400(3-U)	Al.Ch.	720	525	4800
1	2400(3-U)	Whse.	720	600	4800/2400
1	1000	G.E.	514	550	2300
2	500	C.W.	720	575	2300/440
1	500	C.W.	720	250/275	2300/440
1	500(3-U)	Whse.	1200	250	440
1	250	Whse.	1200	125/250	2300
1	200	Whse.	1200	125/250	2300/440
1	200	Ridgway	900	275	2200
1	155	G.E.	720	250	2300/440
1	150	G.E.	1200	500	2300/440
1	100	Al.Ch.	1200	125/250	4000/2300
1	100	Deleo	1200	125/250	440/220
1	100	C.W.	1200	125	440/220
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	4000/2300
1	75	Star	1200	230	440/220
1	75	Whse.	900	75	2200
1	75	Al.Ch.	900	250	2300
1	50	Burke	1750	250	440/220
1	35	Whse.	1750	250	440/220
1	25	Ideal	1750	125	220
3	20	Al.Ch.	1200	250	440/220

DIRECT CURRENT MOTORS

Qu	HP	Make	Type	RPM
1***	3000	Whse.	Encl.(Rev.)	600
1***	2400	Whse.	Encl.(Rev.)	600
4***	1500	Whse.	Encl.(Rev.)	600
4***	1200	Whse.	Encl.(Rev.)	600
4***	800	Whse.	Encl.(Rev.)	600
1	250	G.E.	CD-169-A	1150
1	200/250	El.Dy.	No. 22	400/1200
1	250	G.E.	MPC	325/975
1***	200	G.E.	MPC	400/1200
1	200	Whse.	Mill	300/1200
1	180	G.E.	MPC	400
1*	150	C.W.	83-H	890
1***	125	Whse.	8K-190	600
2	125	Whse.	8K-184	575/850
1	100/125	Rel.	1995-F	300/1200
2	100	Rel.	1050-T	400/1200
1	90/160	G.E.	MPC	625/1125

All above 230-VDC except where marked ***.
*** Pedestal bearing mill design 525/600-VDC.
Rev. designed for mill reversing service.
* T.E.F.C.

We have in stock 100 magnetic panels which we can furnish arranged for your particular requirements.

FREQUENCY CONVERTER SETS

Qu	Make		
1	750-KVA	Elec.Mchy.	440/3/60 to 440/3/180
2	1200-KW	G.E.	2300/3/60 to 460/3/30
1	1700-KVA	Whse.	2300/3/60 to 2500/3/24

The above complete with control panels and starting equipment.

TRANSFORMERS — Power

Qu	Make	KVA	Type	Phase	Voltage
1	G.E.	2760	DH	3	7300/6900-240/480
4	G.E.	333	H	1	13200/1100-2200
3	Packard	250	A	1	13200-2200
3	G.E.	100	H	1	33000-2300
3	Whse.	100	SS	1	12975/10955-230/460
3	Whse.	100	Auto	1	4160/2400-2400/1385
3	Al.Ch.	50	OISC	1	22000-220
2	Uptegraff	37½	HD	1	2300-115/230
2	Kuhlman	13	Dry	1	480-240
45(new)	Al.Ch.	3	OISC	1	2400-120/240

T. B. MAC CABE COMPANY

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.

TRANSFORMERS

3—1250 KVA., Gen. Elec., Type WC, Form VDD, Out-door, 1 ph., 60 cy., 23000/22425/21850 volts primary to 2300/2243/2185-4000Y volts secy.

TURBO GENERATING UNIT

1—100 K.W., G.E. Non-condensing, 3600 RPM. #27,160, 3 ph., 60 cy. 600 volts. (Can be reconnected 480 volts full capacity. Can be reconnect to 240 volts at rating 100 KVA.) Dir. Ctd. exciter.

ARCHER & BALDWIN, INC.
75 West Street New York 6, N. Y.
Tel: BO. 9-9275-9276

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

IMMEDIATE DELIVERY

1—50,000# hr. 4-Drum Stirling type, 250# Boiler (8,500 sq. ft. H.S.) Superheat. Condition excellent, ASME, any fuel, now oil fired.

1—80,000# hr. Steam Generator 350#, Very efficient, economizer, air heater, etc. Steel cased, excellent condition.

768 HP B&W Sterling Boiler, 200#, with new tubes & superheaters.

● We have many other boilers in sizes of 250 to 600 HP, 200 to 450# pressure. See our September Power ad.

Turbo-Generators, Condensing, 300 to 10,000 KW. Non-Condensing, 200 to 2500 KW. Frequency Changers

TRANSFORMERS! Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed.

Motor-Generators & Diesel-Generators See Our September Power Ad

Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK — 30 CHURCH ST. — NEW YORK 7, N. Y.

ELECTRIC AIR COMPRESSORS

676 FT. WORTHINGTON, 2 STAGE
1302 FT. INGERSOLL-RAND PRE-2
2415 FT. INGERSOLL-RAND PRE-2
2600 FT. SULLIVAN WN-4
2873 FT. WORTHINGTON, 2 STAGE
3460 FT. CHGO. PNEU. OCTDE

STANHOPE, 60 E. 42 St., N. Y., N. Y.

500 KW GE SYNCHRONOUS CONVERTERS (3)

HCC6—Steel Frame—1200 RPM Ped. 220/280 V. DC Booster Type—Six Ph. Manual Controls Transformers to suit.

S. M. DAVIS
510 LASALLE ST. — ST. LOUIS 4, MO.

TURBO GENERATOR

Available Immediately

7500 KW G.E. Co. 180 P.S.I.—525° F. Total Temp., 3 phase, 60 cycle, 2300 volt, with Surface Condenser. GOOD CONDITION.

UNION ELECTRIC CO. OF MISSOURI
315 N. 12th Blvd. — St. Louis 1, Mo.

FOR SALE

IMMEDIATE DELIVERY

ROTARY DRYER 8' x 72'—This is a complete plant including: Tipple — skip hoist — elevators — crane runway — Jib crane — electric motors — with reduction gears — transmission and control practically new — at a snap for quick sale.

8 MILE AERIAL TRAMWAY—a complete transportation system with steel loading and unloading terminals—100 steel towers—80—bottom dump buckets, 800 lb capacity—only slightly used—at small fraction of cost.

312 KVA 550/3/60/300 RPM. GENERATOR—with exciter and switchboard—excellent condition.

2—350 H.P. 2300/3/60/257 brand new synchronous motors, exciters and control. These have never been used.

Please send your enquiries and surplus lists—we are a rapidly growing—pioneer country—and have outlets for machinery that would be slow moving—elsewhere.

We are in our 42nd year—We have surprised many important customers by producing precious equipment—for immediate delivery when they thought it could not be done.

SOUL CLINIC INC.
CALGARY, ALBERTA, CANADA
Phones 22030, 25962

FOR SALE

2—Monroe 150 H.P. 72"x16'-0" H. R. T. Boilers in perfect condition including all new steel for hanging same.

2—4 Burner Fyr Feeder Spreader Type stokers with 5'-0" wide x 7'-0" American forced draft grates. Factory New, Never Removed from Crates.

Priced for Quick Sale

LOUIS HAHN & SON
Millvale P. O. — Pgh. 9, Pa.

TURBO-GENERATORS
AVAILABLE IMMEDIATELY

1 6250 kva 5000 kw 3600 rpm Allis-Chalmers 200 lbs. 100° SH condensing. Will operate 275 lbs. 615° TT without change. Generator 3/60/11500 can be changed to 2400/4160 V. Complete auxiliaries—can be operated for inspection. Checked by factory engineer in September 1951—no repairs required.

1 1875 kva 1500 kw 3600 rpm General Electric 150 lbs. 0° SH condensing. Generator 3/60/2300.

1 1567 kva 1250 kw 3600 rpm Allis-Chalmers 140 lbs. condensing. Will operate 200 lbs. 450° TT without change. Generator 3/60/2300. Complete auxiliaries.

1 1250 kva 1000 kw 3600 rpm Westinghouse 185 lbs. 100° SH condensing. 3/60/2300. Completely reworked, generator has new winding. Complete auxiliaries.

1 937 kva 750 kw 3600 rpm General Electric 150 lbs. condensing. Generator 3/60/2300.

1 625 kva 500 kw 3600 rpm Westinghouse 150 lbs. 100° SH non-condensing. Generator 3/60/240.

1 625 kva 500 kw DeLaval geared 5000/900 rpm 150 lbs. condensing. Generator 3/60/2300. Can operate 275 kw 10 lbs. BP without change.

1 187½ kva 150 kw Westinghouse geared 7200/900 rpm 150 lbs. 100° SH non-condensing. Generator 3/60/240.

ALSO IN OUR STOCK

COMPENSATORS, A.C. AUTOMATIC
75 hp 3/60/2300 Cutler Hammer Bul. 9522 w/current limit, fuses. New
125 hp 3/60/2200 G.E. CR7051-H1A.

COMPENSATORS, A.C. MANUAL
100 hp 3/60/220 Allis-Chalmers Type RMC
100 hp 3/60/2200 Westinghouse Type A

CONDENSERS
2—725 sq. ft. C. H. Wheeler 2 pass surface. New

COMPRESSORS, AIR
1200 CFM @ 200 rpm I-R 2 stage 22"x14"x16" short center belt drive.
1000 CFM @ 25 rpm CP 2 stage 20"x12"x14" short center belt drive.

DIESEL GENERATORS
250 kw 400 rpm 3/60/220-440-2200 Superior YLO

ENGINE GENERATORS
2—65 kva 327 rpm 3/60/220 Engberg 9x10 vertical 175 lbs. non-condensing.

GASOLINE ENGINE GENERATORS
50 kw 1800 rpm 3/60/220 Waukesha-Bardco housed on wheels.

GENERATORS, A.C.
375 kva 225 rpm 3/60/220 Allis-Chalmers engine type
250 kw 400 rpm 3/60/220-440-2300 GE engine type
250 kw 1800 rpm 3/60/2200 Westinghouse ped. brgs.
200 kw 720 rpm 3/60 any voltage GE ped. brgs.

GENERATORS, D.C.
75 kw 1200 rpm 125 V. GE single brg.
20 kw 1200 rpm 125 V. GE CDM

OIL CIRCUIT BREAKERS
600 amp. 15000 V. West. FDZ21 o/d solenoid oper.
600 amps. 15000 V. Conduit 511 o/d solenoid oper.

MOTORS, SLIP RING
350 hp 360 rpm 3/60/2200 GE Type IM
200 hp 1800 rpm 3/60/2200 GE Type IE 13B
200 hp 1800 rpm 3/60/440 GE Type IM
100 hp 900 rpm 3/60/440 GE Type MTC5346
75 hp 1800 rpm 3/60/2200 Westinghouse C.W.
2— 75 hp 720 rpm 3/60/2200 Westinghouse HF
50 hp 720 rpm 3/60/2200 GE Type MT552
50 hp 900 rpm 3/60/2200 GE Type IM

MOTORS, SQUIRREL CAGE
125 hp 3600 rpm 3/60/2200 GE Type FT
100 hp 1800 rpm 3/60/2200 A-C Type AR
60 hp 1800 rpm 3/60/220-440 F-M Type H
50 hp 720 rpm 3/60/2200 GE Type KT546

MOTORS, SYNCHRONOUS
400 hp 1800 rpm 3/60/2200 Westinghouse ped. brgs.
300 hp 400 rpm 3/60/220-440-2200 GE engine type
290 hp 720 rpm 3/60 any V. GE Type ATI ped. brgs.
100 hp 1200 rpm 3/60/2200 West. dir. conn. exciter

MOTOR-GENERATOR SETS
1000 kw 600 V. 514 rpm Westinghouse 1440 hp any voltage syn. motor

PUMPS, BOILER FEED
750 gpm 450 lbs. 3600 rpm Goulds 3350 4"—4 stage
475 gpm 750 lbs. 3600 rpm Goulds 3360 3"—6 stage
2—150 gpm 230 lbs. 2750 rpm Frederick steam turbine driven

TRANSFORMERS, 60 CYCLES
2—1000 kva 13800/2300 V. 1 Ph. GE Type H Form VDDJ
3—75 kva 2400-4160/240-480 V. 1 Ph. GE Type H Form KF
3—37½ kva 2400-4160/120-240 V. 1 Ph. GE Type H Form K
131—10 kva 2400-4160/120-240 V. 1 Ph. Various Makes—All modern
28—7½ kva 2400-4160/120-240 V. 1 Ph. Various Makes—All modern

TAMPA ARMATURE WORKS INC.
401 S. MORGAN ST. PHONE 2-1966 TAMPA, FLORIDA

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Qu.	HP	Mfg.	Volts	Type	Fr.	RPM
2	60	Louis Al.	220/440	TEFC	506	1180
1	60	Woods	220/440	TEFC	72	1200
1	100	West.	440	CS		600
1	100	G.E.	440	KT	336	860
1	125	G.E.	440	KT	547	1000
2	*150	Al.-Chal.	2300	ARW		1750
1	200	**G.E.	220	K	564	900

SLIP RING MOTORS—3 Ph., 60 Cy.

1	30	G.E.	220	MT	342	900
1	40	G.E.	220	MT	346	600
1	40	**Al.-Chal.	440	B. Brg.		900
1	50	West.	220	CW		1175
1	75	G.E.	220	MT	436	870
1	100	G.E.	220		16	430
1	*250	C.W.	550	BW	68-CS	1800
1	*300	C.W.	550	BW	68-DS	1800
1	*350	C.W.	550	BW	80-BS	1800
1	500	G.E.	2300		17B	900
1	*600	C.W.	550	BW	80-CS	1800
1	600	West.	440	CW	432D15	1800

SYNCHRONOUS MOTORS—3 Ph., 60 Cy.
With Direct Connected Exciters

1	75	El. Mach.	220			1298
2	125	**El. Mach.	4800			900
5	135	***G.E.	4000	TS	963Z	1200
1	175	Burke	2200	F	40	720
1	*200	**El. Mach.	288			1200
1	*300	**El. Mach.	288			1298
1	*350	**El. Mach.	298			1200
1	*400	**El. Mach.	440			1200

DC MOTORS BALL BRG. MARINE TYPE

Qu.	HP	Mfg.	Volts	Type	Fr.	RPM
1	*70	**Al. Chal.	115	DC	80	2400
1	*12	**Rel.	115	T	46T	1300
2 Vert.	30	**Cent.	230	DN	375Y	1750
2	*50	**Cent.	230	DM	454S	2200
2 Winch	42.5	**G.E.	230	CDM	1830AE	525
3 Winch	50	**West.	230	CK	9	600
8	75	**C.W.	230	TEFC	52H	860
1	75	**Al.-Chal.	230	DEB-1		1150

DC GENERATORS BALL BRG. D.P.

11	25 KW	West.	125	SK	103	1800
7	25 KW	El. Prod.	125			1800
1	30 KW	Burke 1-Brg.	120	WA2	52	1450
2	300 KW	G.E. 1-Brg.	245/280	CY	22I	1200

AC GENERATORS 3/60/440/.8 P.F./1800

11	75 KVA	***West.	1-Brg.
7	75 KVA	**El. Prod.	1-Brg.
1	62.5 KVA	E. M.	2-Brg. 120—208V/900 RPM
1	125 KVA	G.E.	2 Brg.—60-60/120-208-480V

DIESEL ENGINES—PUMPS

TURBINE GENERATORS—M-G SETS
4 New Hercules 135 HP Mod. DWXD
250 KVA Elliott Turbo Gen. 3/60/208V/1200 RPM
150 KW G.E. 3 Brg. Sys. 3/60/220V/1200/240 V/DC
2—100 KW Buckeye AC 3/60/220V/400 RPM
1—200 KW Buckeye AC 3/60/2200V/900 RPM
3—200 KW G.E. AC 440V 1200 RPM Turbo-Generators
Worthington Fire Pump—1000 GPM w/100 HP G.E. KT 540 3/60/220V/1800 w/compensator
*NEW—**BALL BEARING—***SEP. EXCITER

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Brooklyn 7, N.Y.

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HYacinth 5-0800

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3—500 H.P. 450 Lb. B&W Sectional Header Water Tube Boilers, Complete with Stokers, Superheaters, Boiler Feed Pumps, and all Miscellaneous Equipment.
2—250 H.P. Erie City 3 Drum Low Head Boilers, 1942, 200 Lb. Working Pressure, Peabody Burners, Brooks Control Equipment, Pratt-Daniel Stack on each Boiler Pumps, Heater, and Piping.
2—400 H.P. 225 Lb. Bigelow Water Tube Boilers, Oil Firing Equipment. Built 1941.
1—600 H.P. B&W Sect. Header Boiler, 200#.
2—250 H.P. B&W Boiler, Sect. Hdr. 200#, 1931.
1—250 H.P. B&W Boiler, Sect. Hdr., 225#, 1938.
1—500 H.P. Cleaver Brooks Package Boiler, 150 Lbs. #6 Oil, 1947.
A Number of Self Contained & Economic Units, 50-150 H.P., 100-200 Lbs. Pressure.
Combustion Engrg., Spreader Stoker complete with fan & Hagan Controls-Stoker. Designed for 600 H.P. boiler at 200% of rating, or 1200 H.P.
1—6 Cylinder Enterprise Diesel, 800 H.P. direct connected to 1000 K.V.A., 3 ph., 60 cyl., 2400 V. Elliot Generator complete with all aux. Unit built 1948, 1400 hrs. use only.

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4000 KW. 300# Bleeder type, Surf. Cond.
2—1250 KW. 125-180# Cond. price low.
2500-1750 KW. 225#g. 5-15# back press.,
500 KW. 180#g. 30# back press. 440 v.
500 KW. 225#g. 5-15# back pr. 480 v.

BOILERS

100,000 lbs. per hr. 250# Integr. Furnace
87,000# high effic. Steam Generator 350#
also
Transformers: 3—1000 KVA. 13,200/2300 v.
Diesels: 3—400 KVA. 440 v. 514 RPM.
Generator: 3500 KW. 3/60/2300 v.

STEPHEN A. DOUGLASS CO.
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1800 HP Fairbanks-Morse, Model 38D 8-1/8, 8-1/8" x 10", 800 RPM, 10 Cylinder, air start, solid injection, complete with auxiliaries. *Excellent condition.*

480 HP Buckeye Diesel engine, 8 Cylinder, Model 80, 600 RPM, late type. *Rebuilt.*

Other sizes in stock

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STerling 3-6515

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BUCKEYE DIESEL 400 RPM 3/60/240 with V-Belted exciter, Switchgear, Voltage Regulator, Oil filter, Silencer, Water Pump. Engine overhauled.

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SKINNER UNIVERSAL UNAFLOW ENGINE
With full floating piston, automatic stop valve; 200 KVA Electric Machinery Generator; Meters and Switch; Fyr Feeder; Farquahar Coal Conveyor can be seen in operation.

P. O. Box 219, Quakertown, Pa.

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500 (3)	2200	G.E.	900
500	2300	G.E.	450
450	440/220	Whse.	514
350	2300/440	G.E.	450
300	2200	G.E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
270	2300/550	G.E.	450
250	550/440	G.E.	1200
250	440	G.E.	600
200	440	G.E.	450
188	4000/2300	G.E.	1800
150	440/220	G.E.	450
150	440/220	Whse.	600
150	440/220	Whse. (3)	1800
145	4000/2300	G.E.	1800
125	2300/440	G.E.	600
125	550/440	G.E.	1200
100	440/220	G.E.	600
100	440/220	G.E.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2300/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
300	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2300	El. Mchy.	Syn.	600
240	2300/440	G.E.	ATI	720
200	4150/2300	Whse.	Q	1200
150	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/6 volt (or 2,500 amps., 8/12 volts) A.F. Munning, double commutator dir. conn. to 50 hp. G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GE K, 3 pole, 600 v., air
3—1600 amp., ITE, 3 pole, 600 v., air
2—1200 amperes, Whse., 3 pole, 600 v., air
1—400 amp., 37000 V., G.E., Type FHKO-238 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	PT	3600
500	2300/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
300	2200	G.E.	PT	3600
250	440	G.E.	IK	720
250	2200	Al. Chal	AR	1800
200	2200	G.E.	K	200
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
150	440	multi sp.	KT	1800/600
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
150	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
150	440/220	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2200/440	G.E.	K	1200
75 (5)	550	G.E.	KP	1800

A. C. GENERATORS

1—320 kva. 660 rpm, 2300/440/220 V., G.E.
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—187 kva, 1200 rpm, 440 V., Whse.
1—150 kva, 900 rpm, 480/240 v., G.E.
1—100 kva, 720 rpm, 440 V., G.E.
8—75 kva, 1800 rpm, 480/240 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	G.E.	CD	600
150	230 (2)	Whse.	SK	850
125	230	Whse.	SK	350/1050
100	230	El. Dyn.	36-3	475/1250
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—250 kw, 1200 rpm, 250 V., Whse., conn. to 375 HP, 1200 rpm, 2200 V., syn.
1—175 kw, 1200 rpm, 250 V., G.E., conn. to 230 kva, 1200 rpm, 2200/440 V., syn.
1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/400 v., syn. motor.
1—65 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm, 440 V., synchronous.
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage.

TRANSFORMERS 60 CY.

3—333 kva, G.E., 13,200—2300 V.
1—300 kva, Al. Chal. 4800/4160—240/120 V., 3 phase
3—250 kva, G.E., 2400-480 volts.
3—250 kva, Whse., 11,000/22,000—2300 V.
3—200 kva, Whse., 2400—240/120 V.
1—150 kva, Whse., SK, 13200-125/215 v., 3 ph.
3—150 kva, Al. Chal. 2400-240/120 V.
3—150 kva, Whse., 2400-240/480 V.
3—100 kva, Whse., 2400-240/480 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G.E., 4150—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
6— 50 kva, G.E., 2400—120/240 V.
11—50 kva, Whse., 2300-110/220 V., dry

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HYacinth 5-0800

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300 KW 2300/3/60 Vertical Steam Eng Gen Set
8—40 H.P.—550 volt D.C. Street Railway Motors—with trucks—wheels and axles—might consider 250 volt.
2—Pumps—20,000 G.P.M. each—10' head—with or without engines.
300-500 KW 60 cycle Steam Turbine Generator unit
200-300 KW 3/60 Generators, with or without Engines. Please send your enquiries and surplus lists
SOUL CLINIC, Inc., Calgary, Alberta, Can.

WANTED

3—Transformers, Distribution, OISC, 60 Cycle, 1 Phase, 13,200 to 2400 Volt, 1250 or 1000 KVA, with Taps.

CITY OF FORT PIERCE
FORT PIERCE FLORIDA

WANTED

1600 H.P. 3/60 low speed—slipring or syns.
5 H.P. 220/3/60 explosion proof for gassy mine.
750 H.P. 3/60 slipring, low speed 2300 or 550.
250 K.W. Frequency Changer, 3 phase, 4000 volts, both ends, 60 cycle input—25 cycle output.

Please send your surplus lists

SOUL CLINIC, INC., Calgary, Alberta, Can.

FOR SALE

MODERN 1000 KW Turbo-Generator

In Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

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3—100 HP Kewanee Fire Box Oil Fired Type, Open Bottom Boilers. 200# W.P. type HSB, Nos. 7029-7585-8067 National Board Code. Hartford inspected. Rebuilt 1942.

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Vertical Hydro Electric Unit

1—150 KVA. 2400 volts. 60 cycle to operate on a 10-12 ft. head.

HILLMAN LIGHT & POWER CO.
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ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

Acme Electric Co. 268
Air Preheater Corp. *
Allen-Sherman-Hoff Co. Second Cover
Allis-Chalmers Mfg. Co. 22-23, 32 57, 66
Allpax Company 224
Aluminum Co. of America 264, 272
American Blower Co. 33-34
American Brake Shoe Co. (Brake Shoe & Casting Div.) 178
American Chain & Cable Co. 204
American Chimney Corp. 274
American District Steam Co. 179
American Electric Co. 240
American Engineering Co. *
American Manganese Steel Div. *
American Marietta Co. (Valdura Div.) *
American Pulverizer Co. 159
Anchor Packing Co. 173
Anderson Co., V.D. 256
Arkansas Fuel Oil Co. 175
Armstrong Cork Co. *
Armstrong Machine Works 139
Associated Research, Inc. 266, 270
Atlas Valve Co. 214

Babbitt Steam Specialty Co. 240
Babcock & Wilcox Co. 6-7
Badger Mfg. Co. 188
Bailey Meter Co. 12-13
Baltimore & Ohio Railroad 164
Bartlett & Snow Co., C.D. 267
Beloo Industrial Equip. Div. Inc. *
Bell & Gossett Co. 253
Belmont Packing & Rubber Co. 214
Betz Co., W.H. & L.D. 137
Biddle Co., James G. 236
Bigelow Company 170
Bird-Archer Co. *
Bituminous Coal Institute 48-49
Black, Sivalls & Bryson, Inc. 241
Blaw-Knox Construction Co. *
Boiler Engrg. & Supply Co. *
Boiler Tube of America 218
Bonney Forge & Tool Works *
Botfield Refractories Co. 264
Buell Engineering Co. *
Buffalo Forge Co. 143
Buffalo Pumps, Inc. 259
Builders Providence *
Burgess-Manning Co. 251
Bush Mfg. Co. 206
Bussmann Mfg. Co. *
Byers Co., A.M. 72
Byron Jackson Co. 197

Carey Mfg. Co., Philip 195
Cash Co., A.W. 52
Catawissa Valve & Fittings Co. *
Chapman Valve Mfg. Co. 171
Chase Brass & Copper Co. 235
Chelsea Fan & Blower Co., Inc. 264
Chicago Metal Hose Div. Flexonics Corp. 243
Chicago Pneumatic Tool Co. 263
Cities Service Oil Co. 175
Clarage Fan Co. 261
Clark Mfg. Co. *
Clayton Mfg. Co. 172
Cleaver-Brooks Co. *
Clipper Mfg. Co. 201
Coast Metals, Inc. 250
Cochrane Corp. 67
Combustion Engrg.-Superheater, Inc. 42-43
Crane Company 54, 157
Cyclotherm Corp. 208

Darcoid Company 268
Darling Valve & Mfg. Co. 252
Dart Union Co. 202
Davis Regulator Co. 238
Dearborn Chemical Co. 203
DeLaval Separator Co. 247
DeLaval Steam Turbine Co. 2
Deming Co. *
Detroit Stoker Co. 65
Diamond Power Specialty Corp. 8-9
Dodge Mfg. Corp. *
Dowell, Inc. 169
Drew & Co., E.F. 213

Economy Pumps, Inc. (Div. of C.H. Wheeler Mfg. Co.) *
Edwards Valves, Inc. 104
Electric Machy. Mfg. Co. *
Electric Products Co. 177
Elgin Softener Corp. *
Elliott Company 10-11
Engineer Company *
Erie City Iron Works *
Ernst Water Column & Gage Co. 274
Everlasting Valve Co. 226

Farr Company *
Fisher Governor Co. 229
Flexonics Corp. 243
Fluor Corp., Ltd. *
Flynn & Emrich Co. 273
Foster Engineering Co. 198
Foster Wheeler Corp. 20-21
Foxboro Company *
Frick Company 238

Garlock Packing Co. 231
General Cable Corp. 36-37
General Electric Co. (Apparatus Dept.) 26-27, 40-41, 58-59
General Electric Co. (Construction Nat. Div.) 64
Globe Steel Tubes Co. 237
Golden Anderson Valve Spec. Co. 192
Goodyear Tire & Rubber Co. *
Goulds Pumps, Inc. *
Graver Water Conditioning Co. 277
Green Fire Brick Co., A.P. 248
Green Fuel Economizer Co. 180
Grinnell Company Third Cover
Griscom-Russell Co. 257
Gundlach Machine Co., T.J. 194

Hagan Corp. 219
Hall Laboratories 35
Hapman-Button Co. (Dutton Boiler Div.) *
Harbison Walker Refractories Co. *
Hays Corp. 68
Hendrick Mfg. Co. *
Hensley Company 240
Hill Pump Valve Co. *
Hoffman Specialty Co. *
Honan-Crane Corp. 217

Illinois Water Treatment Co. *
Ingersoll-Rand Co. 193
International Nickel Co. 271
Iron Fireman Mfg. Co. 46-47
I-T-E Circuit Breaker Co. 30-31

Jefferson Union Co. 174
Jeffrey Mfg. Co. 38-39
Jenkins Bros. 146-147
Jerguson Gage & Valve Co. *
Johns-Manville 153, 228
Johnson Service Co. *
Johnston Pump Co. 222
Joy Mfg. Co. 149

Keasbey & Mattison Co. 254
Keckley Co., O.C. *
Kellogg Co., M.W. *
Kennedy Valve Mfg. Co. 232
Kennedy-VanSaun Mfg. & Engrg. Corp. 24-25
Kewanee Boiler Corp. *
Key Company 245
Klipfel Valves, Inc. (Div. of Hamilton-Thomas Corp.) *
Koppers Co., Inc. (Coupling Dept.) *

Ladish Company 51
Leads & Northrup Co. *
Leffel & Co., James 228
Leslie Company *
Link-Belt Company 1
Littleford Bros., Inc. (Gen. Div.) 230
Lockett & Co., A.M. *
Lubriplate Div. Fiske Bros. Refining Co. *
Lukens Steel Co. 255
Lumnite Div. Universal Atlas Cement Co. 244
Lunkenheimer Co. 163

Magnolia Metal Co. *
Manning, Maxwell & Moore, Inc. 60, 223
Manzel, Inc. *
Mason-Neilan Regulator Co. *
McGraw-Hill Book Co. 270
Mercoid Company 228
Midwest Piping & Supply Co. *
Industrial Div. Minneapolis-Honeywell Reg. Co. *
Mitchell & Co., W.K. 205
Monsanto Chemical Co. 242
Mundet Cork Corp. *
Murray Mfg. Co., D.J. 224
Murray Iron Works Co. 222

National Airoil Burner Co., Inc. 184
National Aluminate Corp. 145

National Boiler Protector Co. ..... *
National Conveyors Co., Inc. 238
National Tube Co. 44-45
National Valve & Mfg. Co. 246
Weff & Fry Co. ..... *
Niagara Blower Co. 210
Nicholson & Co., W.H. 218
Nordberg Mfg. Co. 227
Northern Equipment Co. 18-19

Oakite Products, Inc. 266
Ohio Injector Co. 189
Owen-Illinois Glass Co. (Kaylo Div.) 221

Pabco Products, Inc. 182
Pangborn Corp. 194
Parker Appliance Co. 176-177
Peabody Engineering Co. 220
Peerless Pump Div. (Food Machy & Chem. Corp.) ..... *
Penberthy Injector Co. 211
Penfield Mfg. Co., Inc. 270
Perfex Corp. ..... *
Permutit Company ..... Back Cover
Philadelphia Gear Works 185
Pick Mfg. Co. ..... *
Pipe & Tubular Products, Inc. ..... *
Pittsburgh Piping & Equipment Co. 258
Powell Co., Wm. 209
Powers Regulator Co. 129
Preferred Utilities Mfg. Co. ..... *
Pritchard & Co., J.F. ..... *
% Proportioneers Inc. % ..... *
Pure Oil Company 191
Pyramid Instrument Corp. 265

Read Standard Corp. ..... *
Reading, Pratt & Cady Div. 204
Refinite Corp. ..... *
Republic Flow Meters Co. 70-71
Republic Steel Corp. 62-63
Research Corp. ..... *
Revere Copper & Brass, Inc. ..... *
Rhoads & Sons, J.E. ..... *
Ric-Wil Company 240
Riley Stoker Corp. 102-103
Rohm & Haas Co. (Resinous Prod. Div.) ..... *
Roto Div. of Elliott Co. 190
Rust-Oleum Corp. ..... *

Sarco Company 187
Schaub Engrg. Co., Fred H. ..... *
Schramm, Inc. ..... *
Sexauer Mfg. Co., Inc. ..... *
Sier-Bath Gear & Pump Co. ..... *
Sinclair Refining Co. ..... *
Skinner Engine Co. 186
Smith Refractories Inc. Sanford 274
Socony-Vacuum Oil Co. ..... *
Spence Engineering Co. 200
Springfield Boiler Co. 53
Squires Co., C.E. ..... *
Standard Oil Co. of Indiana 141
Steel & Tubes Div. 62-63
Stephens-Adamson Mfg. Co. 55
Sterling Engrg. & Mfg. Corp. 274
Stickle Steam Specialties Co. ..... *
Sticht Co., Herman H. 274
Stock Equipment Co. 207
Stone & Webster Engrg. Co. 199
Strong, Carlisle & Hammond Co. 212
Struthers Wells Corp. (Titusville Iron Works Div.) 230
Sun Oil Company 135
Superior Combustion Industries 61, 167
Swartwout Company 161

Taylor Instrument Co.'s 269
Terry Steam Turbine Co. ..... *
Texas Company ..... *
Tidewater Associated Oil Co. 151

Union Asbestos & Rubber Co. 240
Union Iron Works ..... *
United Cooling Tower Co. ..... *
United States Gasket Co. 216
U. S. Electrical Motors, Inc. 233-234
U. S. Steel Corp. 44-45

Viking Pump Co. ..... *
Vogt Machine Co., Henry 54
Vulcan Soot Blower Corp. 14-15

Wallace & Tiernan Products, Inc. 196
Walworth Company 249
Warren Steam Pump Co. ..... *
Water Cooling Equipment Co. ..... *
Watson-Stillman Co. 225
Western Chemical Co. ..... *
Western Precipitation Corp. 302
Westinghouse Electric Corp. 16, 155
Westinghouse Electric Corp. (Sturtevant Div.) ..... *
Wheeler Mfg. Co., C. H. 239
Where to Buy 274
Wickes Boiler Co. 183
Wiedeke Co., Gustav ..... *
Williams Valve Co., D. T. 181
Wing Mfg. Co., L. J. 266
Winger Construction Co. 268
Worthington Pump & Machy Corp. 17, 50
Wright-Austin Co. ..... *

Yarnall-Waring Co. 4, 28-29, 131
Youngstown Sheet & Tube Co. 215

Zallea Bros. ..... *

Professional Services 274

SEARCHLIGHT SECTION

(Classified Advertising)

H. E. HILTY, Manager

EMPLOYMENT
Positions Vavant 278
Selling Opportunities Offered 278
Positions Wanted 278
Employment Services 278

SPECIAL SERVICES
Rebuilding 292
Repairing 299

EDUCATIONAL
Books 299

EQUIPMENT
(Used or Surplus New)
For Sale 279-299

WANTED
Equipment 299

ADVERTISER'S INDEX
AAA Iron Co. 295
Aljon Electric Diesel Co. 295, 298
Allied Chemical & Dye Corp. 278
Allied Electric & Machy Co. 299
American Air Compressor Corp. 296
Archer & Baldwin 297
Arrow Transformer Co., Inc. 291
Bauer, L. W. 299
Belyea Co., Inc. 282
Benkart Steel & Supply Co. 299
Benson-Williamsig, Inc. 292
Boiler & Equipment Co. 291
Boston Metals Co. 286
Boswick Electric Co. 290
Brew, Woltman & Co., The 291

C-B Equipment & Pump Co. 295
Chicago Electric Co. 283
Crown Machinery 299

Davis, Samuel M. 292, 294, 297
Donoghue, Stephen S. 299
Duquesne Electric & Manufacturing Co. 295
Douglass Co., Stephen A. 298

Ebasco Services, Inc. 295
Electric Equipment Co. 287
Electric Generator & Motor Co. 289
Electric Service Co., Inc. 292
Ellis Co.; A. Leo 296
Erie Electric Co., Inc. 296

Ft. Pierce, Fla., City of 299

Glow Electric Co. 294

H & P Machinery Co. 292
Hall & Co., Stephen 299
Hahn & Son, Louis 297
Heller Co., Albert 298, 299
Hemphill & Co., J. L. 292
Hillman Light & Power Co. 299
Howe Brothers 294

International Power Machinery Co. 288

Johnson & Assoc., H. Blane 292

Kane-McGuire Co. 293
Keystone Power Plant Equipment Co. 292
Kings County Machinery Exchange 290
Kirk Co., Wallace E. 289
Knox Co., Earl E. 293

Land, Inc., J. L. 279
Ledbetter Manufacturing Co. 294
Lefax 299

MacCabe Co., T. B. 297
Manganese, Inc. 295
McGrath Co., H. J. 294
Midwest Utilities Power Equip. Corp. 290
Mississippi Valley Equipment Co. 289
Moorhead Electrical Machinery Co. 294
Morse Bros. Machinery Co. 289

Neiswander, Robert L. 298
Newman & Co., Inc. 299

O'Brien Machinery Co. 281

Penn Machinery Co. 291
Pierce Cable Co. 299
Power Equipment Co. 293

Rearick, Charles B. 297

Sandman Electric Co., Inc. 291
Schoonmaker Co., Inc., A. G. 288
Sherb, Warner J. 298
Soul Clinic, Inc. 297, 299
Stanhope, Inc., R. C. 297
Stephenson & Co., Dell 295
Strickler & Assoc., Dean G. 293
Superior Equipment Co. 296
Superior No. Shore Power Co. 296

Tampa Armature Works, Inc. 298
Thompson Co., Inc., J. Parker 296
Tippins Machinery Co. 294

Union Electric Company of Mo. 297
Universal Wire & Cable Co. 299
Utilities Machinery Corp. 280

Wagner Co., Arthur 285
Walker & Collins 299
Wayne Electric & Manufacturing Co. 290
Weaver, Charles 284

In Plant After Plant—

One of America's Largest Auto Manufacturers Has Selected MULTICLONES for Fly Ash Recovery!

Over 35 MULTICLONE Units To Date in Various Plant Divisions!

A Few of *Many* MULTICLONE Advantages!

POINT 1 —It Saves Space!

Plant space costs money. Because the Multiclone makes *really important* savings in space, it makes similar savings in plant costs. The chart tells only part of the story because, in addition to being far more compact both in square and cubic footage, the shape of the Multiclone can be adjusted to fit various space requirements—either long and narrow, short and wide, or square. You can often fit the Multiclone into tight spaces or waste areas too small for other equipment!

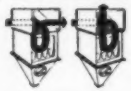
Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

POINT 2 —It Recovers the "Fines"!

Because its exclusive vane design and small diameter tubes generate higher centrifugal forces, the Multiclone recovers a large percentage of even the very fine particles 10 microns and less as well as the heavier particles. Multiclone's high recovery of both small and large particles means high overall collecting efficiency.

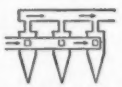
POINT 3 —It is Unusually Adaptable!

In addition to the shape adaptability outlined above, Multiclone's inlet-outlet connections are also readily adaptable to plant restrictions. Where headroom is low, install the Multiclone with side-inlet, side-outlet. Where side clearances are small, use side-inlet, top-outlet arrangement. Or still other arrangements are possible!

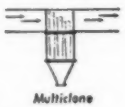


POINT 4 —It is Simple!

Both installation and maintenance of the Multiclone are unusually simple. For example, the Multiclone requires only a *single* inlet and a *single* outlet duct compared with the complicated multiple ducts of conventional cyclones. This not only saves space—but is simpler and cheaper to install and insulate. Moreover, the Multiclone has no filters to replace, no high-speed moving parts to maintain, nothing to require frequent cleaning or repair . . . and a *single* collecting hopper serves many tubes!



Conventional Cyclone



Multiclone

POINT 5 —Still Other Advantages!

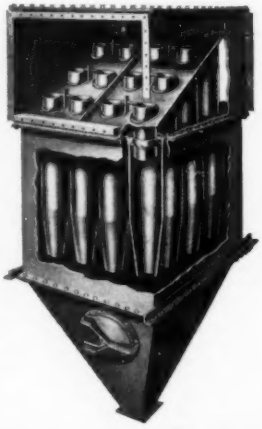
The above advantages are by no means the complete story on Multiclone savings. Get *all* the facts before you decide on *any* recovery installation.

Send for this Multiclone booklet!

COTTRELL PRECIPITATORS · MULTICLONE COLLECTORS · TURBULAIRE SPRAY DRYERS

YEAR AFTER YEAR—in plant after plant—one of the nation's largest automobile manufacturers has selected Multiclone Collectors for recovering fly ash and dust in its many manufacturing divisions. This repeated selection of Multiclones—now totalling over 35 units—is high testimony to the many vital advantages found in Multiclone equipment. Check over some of these advantages as outlined at left . . . advantages that will save space—cut installation costs—boost recovery efficiencies—minimize maintenance and make other important savings on *your* recovery operations, too.

Then consider this fact . . . Any *one* of these advantages is sufficiently important in itself to make Multiclone equipment the logical choice for your recovery operations. But when you realize that the Multiclone offers definite, clear-cut advantages on *every* qualification essential to maximum efficiency and economy in recovery operations you have some idea of the far-reaching savings you will make by installing Multiclone.



Let us give you further information on Multiclone recovery equipment. A letter, wire or phone call to our nearest office places the information in your hands without obligation. Get *all* the facts—and you'll get Multiclone!

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ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

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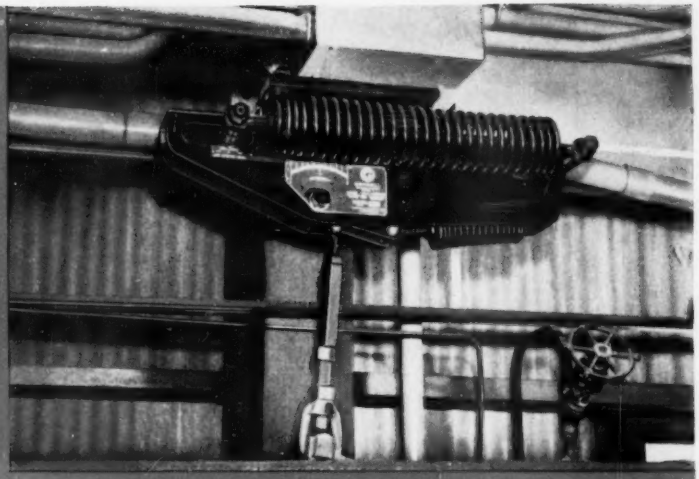
PIPING THAT MOVES

. . . calls for supports that are flexible



Grinnell Model L Constant-Support on 12-inch main steam at Somerset Power Station, Montaup Electric Co., Somerset, Mass. Pressure, 1300 psi; temperature, 950°F; load, approximately 4000 pounds. Note minimum headroom available.

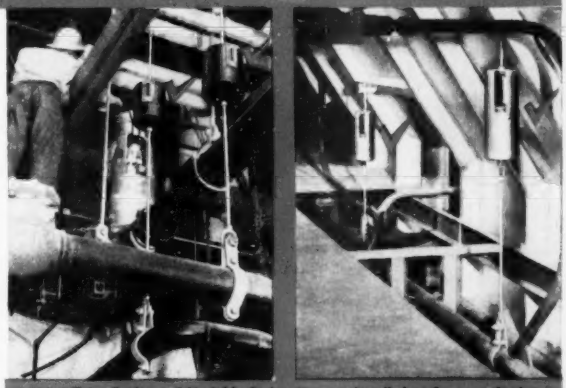
Thermal deflection of piping in today's high pressure, high temperature power stations necessitates flexible support of piping.

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant-support type hangers are recommended. They are designed to provide substantially uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

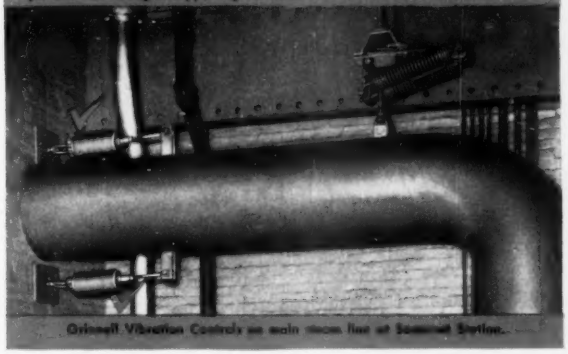
When pipe lines are subject to vertical movement and restrictive conditions do not require the use of a constant-support type, variable spring hangers are recommended. They should be designed to support not less than 85% or more than 120% of the designed load for the total travel.

When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting, counter force type are recommended.

Grinnell manufactures a complete line of engineered pipe hangers and supports; maintains a laboratory staff of trained technicians; provides highly skilled assistance and advice right from the design stage; and offers experienced field engineering service.



Grinnell Pre-Engineered Variable Spring Hangers installed at Somerset Station. Left: supporting boiler feed discharge lines, carrying steam at approximately 1785 psi and 455°F. Right: supporting the boiler blow-down header and lines.



Grinnell Vibration Controls on main steam line at Somerset Station.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

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pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
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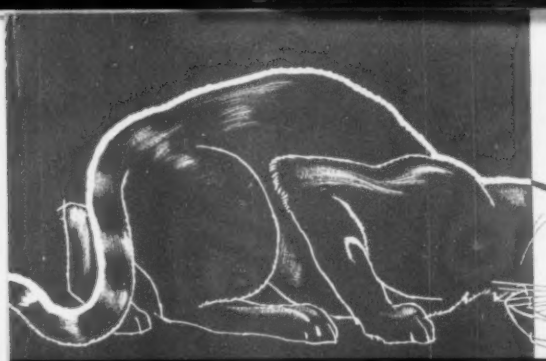
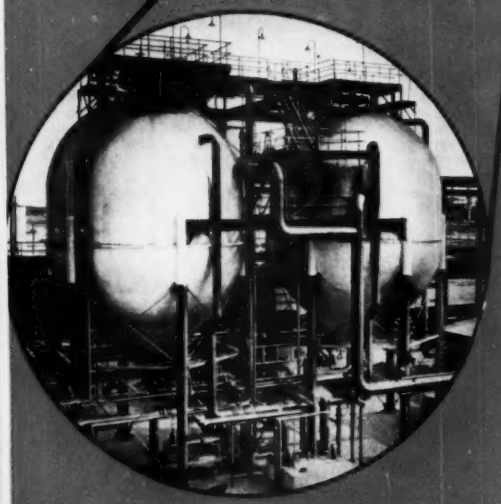


BIG "CATS" NEED GOOD WATER TOO . . .



Permutit two-stage hot lime soda and phosphate water softener recently installed at The Texas Company's Eagle Point Refinery.

WATER CONDITIONING HEADQUARTERS FOR 40 YEARS

—*and Permutit Equipment brings it, at lower cost, to The Texas Company's new Eagle Point "cat" crackers . . .*

The Texas Company, at their Eagle Point Works in Westville, N. J., processes 60,000 barrels of crude per day, in which processing modern fluid catalytic cracking is used. Over-all refinery steam and electric power balance dictated refinery boiler plant operation at 900 psi. Treated water is used on waste heat boilers on the cat cracker. They operate a Permutit two-stage hot lime soda and phosphate water softener to protect their boilers against scale and corrosion. Permutit equipment and its location are illustrated.

The Texas Company is but one of many concerns which realizes the value of proper water softening. To solve water conditioning problems, manufacturers in hundreds of industries have turned to Permutit. With 40 years of experience in water treatment, Permutit possesses the know-how to solve water conditioning problems economically at lower initial cost, with greater continuing savings.

For aid in the solution of your own water problems, write to The Permutit Company, Dept. P-4, 330 West 42nd Street, New York 36, N. Y. or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

PERMUTIT